SURGICAL EMERGENCIES

PERCY SARGENT

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SURGICAL EMERGENCIES

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LONDON

HENRY FROWDE
Oxford University Press

HODDER & STOUGHTON
Warwick Square, E.C.

1907

OXFORD : HORACE HART
PRINTER TO THE UNIVERSITY

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PREFACE

This little book lays no claim to completeness. It is rather of the nature of an Essay based upon an experience gained during some eight years' intimate association with the Surgical Side of St. Thomas's Hospital. As such it must necessarily embody to a large extent the teaching and practice therein adopted, but whatever faults are to be found in it are to be ascribed to the Author, and not to those whose teaching he may be presumed to reflect. If any apology is needed for the dogmatic tone adopted, it is that those for whose use the book is intended require in any emergency, not academic discussions concerning the relative value of different methods, but explicit directions as to some definite line of treatment, which, if not always the best, has at least the merit of having been found by experience to be sufficiently good.

The chapter on the Eye has been written by Mr. C. J. Cunningham, and the Author acknowledges with gratitude the valuable assistance of his colleague, Mr. H. J. Marriage, in the preparation of the chapter on the 'Affections of the Ear'.

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CHAPTER I

HAEMORRHAGE

HAEMORRHAGE is the most pressing of all surgical emergencies. The escape of blood from an artery may be so rapid as to cause death in a few seconds, but it must not be forgotten that venous haemorrhage also may prove rapidly fatal, and that even capillary haemorrhage if unchecked may lead to most serious consequences.

The old distinctions of primary, reactionary, and secondary haemorrhage still hold good, and although under modern conditions secondary haemorrhage is of uncommon occurrence, yet the surgeon must always be prepared to encounter and deal with it. *Primary* haemorrhage is that which occurs immediately from a wounded vessel; *reactionary* or *recurrent* haemorrhage is merely a restarting of the primary bleeding a short time after the injury

4 5

or operation ; *secondary* haemorrhage is the result of softening of the vessel-wall by some pathological process. Primary haemorrhage may thus be compared with an ordinary fracture of a bone, secondary haemorrhage to a 'spontaneous' fracture in a bone which is the seat of a morbid growth.

Occasionally secondary haemorrhage occurs after the ligation of a large artery in its continuity owing to the vessel-wall, weakened by the traumatism, being unable to resist the force of the blood-stream. But as a general rule secondary haemorrhage is the result of sepsis, and it is upon this fact that much of the difficulty of its treatment depends.

I. PRIMARY ARTERIAL HAEMORRHAGE

Temporary arrest of such haemorrhage is to be secured either by digital pressure, by the application of a pair of pressure-forceps, or by the use of a tourniquet. As soon as the necessary preparations can be made the bleeding-point must be found and ligatured.

It sometimes happens that a wound has been made in the near neighbourhood of a large vessel,

and that, when the surgeon sees the case, no haemorrhage is in progress. The question then arises as to whether any active measure should be taken. The following rule should be followed :—

If the bleeding is known to have been profuse, or if there is a large or an increasing subcutaneous haemorrhage, particularly if pulsation is felt in the swelling, then operation must be undertaken. There are four chief reasons for taking this step :—

(*a*) The haemorrhage may recur at any moment.

(*b*) Widespread subcutaneous haemorrhage is apt to be followed by septic complications.

(*c*) The pressure of the effused blood may be severe enough to cause gangrene of the limb.

(*d*) A traumatic aneurysm may result.

The object of operating is to reach and ligature the vessel at the point of injury. The reasons for choosing to tie the bleeding-point itself are :—

(*a*) It is not always certain what vessel is wounded. A stab in the upper part of the thigh, for instance, may have wounded either the superficial or deep femoral arteries. In the latter case ligation of the superficial femoral would not only fail to arrest the

haemorrhage, but would also involve considerable risk of gangrene.

(*b*) Ligation of the wounded vessel at a distance, together with obliteration of the vessel at the site of injury, necessitates the subsequent dilatation of two sets of collateral vessels instead of one, and thus increases the risk of gangrene.

(*c*) It is necessary to ligature the vessel below as well as above the wound, for otherwise recurrent haemorrhage may take place as soon as the collateral circulation is established.

Operation. The skin, and wound if there be one, should be cleansed as thoroughly as possible, the opening enlarged, clot removed, and a search made for the wounded vessel. This may prove to be a task of no little difficulty.

During the manipulations an assistant should be ready to control the main artery. If found, the artery must be tied above and below the wound, and divided between the two ligatures. If after careful search the bleeding-point cannot be found, a plug of sterile gauze should be packed tightly into the wound, beginning at its deepest point,

and a firm bandage applied. It sometimes happens that at the bottom of a deep wound, the bleeding-point can be secured with artery forceps but cannot be tied. In this case the forceps should be left *in situ* for forty-eight hours, the dressing being applied around and over the handles.

II. REACTIONARY HAEMORRHAGE

This is merely a recurrence of the primary haemorrhage, and, as its name indicates, is due to the rise of blood-pressure which accompanies recovery from loss of blood or from the shock of an operation. This increase of blood-pressure may bring about the slipping of a badly-tied ligature, or the displacement of a clot from a wounded but unligatured artery. Usually the escape of blood externally will call attention to the accident. Such, for example, will be the case in haemorrhage from the lingual artery after excision of the tongue. In other cases pain and increasing distension of the tissues in the neighbourhood of the wound will point out the accident. In such cases it is usually necessary to give an anaesthetic, reopen the wound, clear away the

clot, and tie the bleeding vessel. But severe and even fatal post-operative haemorrhage may show itself only by the general symptoms occasioned by loss of blood. For example, after an operation for haemorrhoids, the blood, prevented from escaping externally by a tightly contracted sphincter, may make its way into and distend the rectum. Such an accident has even been known to prove fatal. Still more grave is intra-abdominal haemorrhage, because a large quantity of blood may escape into the peritoneal cavity in a short time, as, for example, if a ligature slips from the stump of an ovarian pedicle, or from a piece of omentum or mesentery. The treatment of intra-peritoneal haemorrhage is dealt with in the chapter on Abdominal Injuries.

III. SECONDARY HAEMORRHAGE

Secondary haemorrhage is almost always due to septic softening of a vessel-wall, such as may result from an infected ligature, from the exposure of a vessel in a septic wound, or from the involvement of a vessel in an ulcerating malignant growth. The

bleeding may be sudden, unexpected, and profuse, or it may give some warning of its approach by the escape from time to time of larger or smaller quantities of blood along with the purulent discharge. The possibility of secondary haemorrhage must always be borne in mind when suppuration takes place in close proximity to a large vessel. When the haemorrhage is at all severe it must be temporarily controlled by pressure either at the bleeding-spot or upon the main artery, or by the use of a tourniquet, whilst steps are being taken for its permanent arrest.

As in primary, so in secondary haemorrhage the golden rule is to deal with the bleeding-point itself. The only valid reason for not doing so is its inaccessibility. But in secondary haemorrhage the local conditions are different on account of the septic state of the tissues. The principles upon which the treatment is to be based are

(i) The wound must be thoroughly opened up, and cleansed as far as possible. Free drainage is essential if the suppuration is to be arrested and the risk of further haemorrhage minimised. No harm can result from irrigation of the wound with a non-poisonous

antiseptic such as formalin or hydrogen peroxide.

(ii) The bleeding-point must be identified, and the vessel ligatured. If the haemorrhage has occurred from an artery in its continuity, the vessel must be tied both below and above the bleeding-point.

Should the application of a ligature prove impossible either on account of the softness of the vessel-wall or on account of its depth in the wound, a pair of artery forceps should be applied and, if the bleeding is thereby controlled, the forceps should be left *in situ* for forty-eight hours. If neither of these methods is practicable, and the haemorrhage is not very severe, the cautery may be tried or the wound tightly plugged from the bottom with gauze.

It is only when none of these methods prove successful that the main artery is to be tied at a distance from the wound. Sometimes it is necessary to combine the two methods, namely, ligature of the main vessel and plugging of the septic wound. The following case is a good illustration. A patient had had the tongue excised by

Kocher's method. Ten days after the operation there was a sudden profuse haemorrhage both from the mouth and from the wound in the neck. Pressure upon the common carotid artery at once checked the bleeding ; the wound was freely opened, but the bleeding-point could not be secured. The common carotid was therefore ligatured, thereby checking but not completely arresting the haemorrhage, and the wound was tightly plugged. The patient only survived for a few hours, and at the autopsy it was found that the haemorrhage had proceeded from the internal carotid artery the wall of which was softened and ulcerated.

IV. VENOUS HAEMORRHAGE

Haemorrhage from a large vein may be very profuse and even fatal. A large varicose vein in the leg may give way and cause very severe bleeding, or the lateral sinus may be opened either accidentally during a mastoid operation, or secondarily by ulceration when exposed in a foul mastoid wound. During operations on the neck, large veins

may be torn and give rise to very troublesome haemorrhage.

The principles of treatment are quite different from those which obtain in the case of the arteries, because there is not the same high blood-pressure to be reckoned with. If, therefore, the vein cannot be ligatured, or secured by means of artery forceps, the pressure of a firm plug will suffice to arrest the haemorrhage permanently, and without fear either of recurrent haemorrhage or of the subsequent development of an aneurysm.

V. HAEMORRHAGE IN SPECIAL REGIONS

Whilst the general principles just laid down should suffice for dealing with haemorrhage from any accessible point, it is perhaps advisable to indicate briefly how best to treat some more or less common varieties in certain special regions. Many of these are discussed elsewhere under their respective headings, as Intracranial haemorrhage, Intraperitoneal haemorrhage, Haematuria and Haemothorax, but there are certain others which deserve separate mention :—

(a) *Epistaxis*

Blood may escape from the nose as a symptom of some general condition such as haemophilia, certain other blood diseases, and cirrhosis of the liver; or as a symptom of fracture of the base of the skull; or from some purely local condition such as direct injury, ulceration into a vessel, or the presence of a tumour.

Treatment. Usually the bleeding will cease spontaneously with rest in the recumbent position and the application of cold to the forehead. If it proves persistent, the nasal cavity must be plugged, and there are various means by which this may be accomplished. The simplest method is that of introducing a strip of gauze, wetted with a five per cent. solution of adrenalin, by means of a probe. If it is available one of the inflatable rubber bags, constructed for the purpose, may be used: these are introduced, when empty, by means of a pair of curved forceps, and then inflated. The posterior nares may be plugged as follows: a roll of gauze, 'the size of the last joint of the thumb,' is tied round its middle with a long silk thread. A soft

catheter is next passed along the floor of the nose into the nasopharynx, and then hooked forward into the mouth with the left forefinger. The silk thread mentioned above is then tied to the end of the catheter, and the instrument withdrawn from the nose carrying the silk with it, until the gauze roll is felt to rest against the posterior nares. A second plug is then placed against the nostril, and the silk thread tied round it, thus securely blocking both nostril and posterior nares.

(b) *Haemoptysis*

Nothing surgical can be done for this condition. If the bleeding is taking place from a large vessel death will speedily ensue: otherwise the haemorrhage will cease spontaneously, aided by absolute rest in the recumbent position and the administration of morphia subcutaneously. But for the detailed treatment of haemoptysis the reader is referred to works on Medicine.

(c) *Haematemesis*

The general consensus of opinion amongst surgeons is that haemorrhage from the stomach will

almost invariably cease with general and drug treatment, and but rarely proves fatal. Occasionally it is so persistent that an exploratory gastrotomy is called for, when the bleeding-point may be secured ; but, on the other hand, the stomach may be opened and neither ulcer nor bleeding-point found. Gastrotomy for haemorrhage *per se* is an operation rarely if ever to be recommended.

(d) *Haemorrhage after certain operations*

(i) From the lingual artery after excision of the tongue. If a silk thread has been left attached to the stump of the tongue, as should always be done on account of its liability to fall backwards and impede respiration, the bleeding can be temporarily arrested by simply pulling upon the thread. If this fails, the finger should be introduced behind the tongue, and the stump hooked forward. As soon as a good light, instruments, and assistance are available, the artery should be sought for upon the face of the stump, and secured.

(ii) After operations for haemorrhoids. Serious and even fatal bleeding has been known to take

place into the rectum after such an operation, the blood being prevented from escaping externally by a tightly contracted sphincter. Pain is experienced, and the symptoms of internal haemorrhage gradually assert themselves. If this accident is suspected, an anaesthetic must be given, the sphincter dilated, and the bleeding-point or points secured.

(iii) After excision of a varicocele. This is an accident which occurs occasionally as the result of tying the ligature insecurely, or cutting the veins off too closely to the ligature. When it is remembered that the spermatic artery is included in the part of the spermatic cord that has been cut across, it is not surprising that the slipping of the ligature from the proximal end should be followed by extensive bleeding into the subcutaneous tissues. The lower part of the abdominal wall and the scrotum very rapidly become infiltrated with blood. When this accident happens, there is no course open but to give an anaesthetic, reopen the wound, and tie the bleeding vessel, at the same time removing as much blood and clot as possible.

(e) *Haemophilia*

In the victims of this disease, persistent, uncontrollable, and even fatal bleeding may occur even from a trivial wound. It is specially liable to occur from lesions about the mouth, as, for instance, from a tooth-socket. Wherever possible, firm pressure must be applied, and the plug or pad used may with advantage be soaked in some styptic solution such as adrenalin or ferric chloride. Occasionally, when these measures fail to arrest the oozing, the thermo-cautery may be employed. At the same time drugs should be given internally, with a view to increasing the coagulability of the blood, such as calcium chloride and liquor hammamelidis.

GENERAL SYMPTOMS OF HAEMORRHAGE

Whether the blood escapes externally, or internally, as into the peritoneal cavity, certain general signs soon begin to manifest themselves. These are a feeling of faintness, restlessness, sighing, yawning, and disturbances of vision. At the same

time the patient becomes cold, pale, and anxious, and the pulse-rate steadily increases.

Treatment. The first care is to prevent the further loss of blood by one or other of the means indicated above. When this has been done, and not until then, stimulants may be administered, warmth applied by means of hot bottles, and, above all, fluid supplied to take the place of that which has been lost, by one or other of the methods described below. The head must be kept low, and absolute rest secured, with the assistance, if necessary, of sedative drugs. The patient is usually very thirsty, a symptom which points to the obvious and natural means of supplying fluid to the circulation. It is, therefore, both cruel and unnecessary not to allow him to drink freely. The firm bandaging of the limbs from below upwards is a means of supplying blood to the more important parts of the body which should not be neglected.

SALINE INFUSION

In order to supply fluid rapidly to make up for the loss of blood, several methods may be adopted

according to the urgency of the case. The fluid to be used is sterilized normal saline solution, which can readily be made by dissolving a drachm of common salt in each pint of water.

Rectal. Fluid is rapidly absorbed into the circulation from the rectum, and is the method which should be employed if the case is not very urgent. From half a pint to a pint of saline solution can be retained by an adult, and should be introduced by means of a tube and funnel into the rectum, the pelvis being raised, at intervals of from one to two hours.

Subcutaneous. In children, saline solution is absorbed fairly rapidly from the subcutaneous tissues, and may be given with an antitoxin syringe. A modification of this method is known as that of 'continuous infusion', and is used as follows. A large 'antitoxin needle' is connected with a long piece of rubber tubing connected with a vessel containing sterilized saline solution. The needle is introduced into the subcutaneous tissue, most conveniently in the flank or chest-wall, and the vessel is suspended above the bed at such a height

as to ensure the fluid being forced slowly into the subcutaneous tissue. The temperature of the fluid must be kept constantly at 105° F., and every care must be taken to maintain strict asepsis. In this manner many pints can be introduced into the circulation in the space of a few hours, but it is a tedious and painful method, and requires the undivided attention of a nurse.

Intraperitoneal. In abdominal operations the fluid may be left in the peritoneal cavity, from which it is rapidly absorbed into the circulation, but the amount which can be thus introduced is not large, and the method is only capable of limited application.

Intravenous. This is the most rapid and efficient way of introducing fluid into the circulation and is the one most generally applicable. The apparatus required consists of a scalpel, artery forceps, scissors, aneurysm-needle, cannula, rubber-tubing and funnel, thermometer, and measure-glass.

Operation. The skin over the front of the elbow having been thoroughly cleansed, the largest vein visible is selected and exposed by an incision an

inch in length. By means of the aneurysm-needle two silk ligatures are then passed beneath the vein ; the lower one is tied, and the upper left loose. The funnel, tube, and cannula, all previously sterilized, are then completely filled with sterilized saline solution at 105° F. (to which may be added a little brandy if necessary), so as to exclude all air bubbles ; a small oblique incision is made into the vein and the cannula introduced in an upward direction into it. The ligature which was left loose is now tied with a single hitch so as to hold the cannula in place. When sufficient fluid has been introduced the cannula is withdrawn, the ligature tied tightly, and the wound sutured.

CHAPTER II

BURNS AND SCALDS

A BURN is defined as the lesion occasioned by dry heat, a scald as that which results from moist heat. Except that a scald is usually of less severe degree, the distinction is not of any practical importance, and the term 'burn' will here be used to include both classes of injury.

DEGREES OF BURNS

Burns are commonly described, according to their depth, as being divided into several degrees; but in practice it is not possible to distinguish them with any accuracy. Moreover, several degrees are commonly present together, especially if an area of any considerable extent is involved. The degree, however, speaking generally, determines the mode of treatment, the amount of deformity which will remain, and to some extent the severity of the constitutional symptoms.

A burn of the *first* degree, producing only a hyperaemia, leaves no permanent mark. The *second* degree is that of vesication, and leaves no trace beyond perhaps a little brownish pigmentation. The *third* degree involves destruction of the superficial layers of the epidermis, but leaves intact the deepest layer of epithelial cells lying between the bases of the papillae. This point is of the greatest importance, because it means that regeneration will take place with a minimum amount of scarring. The ultimate result of a burn of this degree is a whitish, supple scar, but with very little contraction and deformity. In the fourth and succeeding degrees the whole depth of the skin is involved and the destruction may extend to any distance into the subjacent tissues. Such a burn entails healing by granulation, giving rise to the formation of much cicatricial tissue, and consequently by its contraction to very serious deformity.

In forming an opinion upon any case of burn there are two principal points to be considered, firstly, the danger to life and health, and secondly, the outlook as to permanent disfigurement and

deformities. The considerations bearing upon the first point are *age*; *previous history*, especially as regards alcohol and visceral disease; *extent*, *situation*, and *degree* of the burn; and the *treatment* adopted from the first. Those influencing the second point are the *depth* or degree, *extent*, *situation*, and the *treatment* adopted.

With regard to the immediate outlook, the extent of a burn is of greater importance than its depth, but as regards the subsequent progress of the case it is the degree which is the more important. Again, the situation is a factor of considerable moment, burns in such regions as the trunk, genitals, and perineum being more serious than those of the back and extremities.

Thus a superficial burn involving a large area of skin, especially about the chest or abdomen, is far more dangerous than a smaller burn of more severe degree. In children this is especially true, and it must be borne in mind that burns in young children are particularly grave injuries, and are attended by a high rate of mortality.

Treatment. This must be directed to three chief

ends, firstly, that of the initial shock, which is always present, often severe, and not infrequently fatal; secondly, that of the septic condition which almost invariably follows, and which may occasion severe symptoms and complications; and thirdly, every effort must be directed to the prevention of subsequent deformity and disfigurement.

Unfortunately, when the patient comes under the surgeon's care, the burnt surface has usually been covered with some greasy or oily substance, which favours the supervention of sepsis. The application of oil is said to alleviate pain, but this is not a point of importance, because as a rule a bad burn gives rise to little or no pain, because the patient is in a condition of collapse. This is a point of some interest, because the degree to which pain is absent is an indication of the severity of the shock.

The shock is chiefly due to the exposure of nerve endings and fibrils over an area of large extent. One means of combating the shock therefore lies in the protection of the raw surface, and this is best done by the application of a saturated solution of picric acid. This non-poisonous substance coagu-

lates the albuminous exudate, and is supposed to form a protective covering for the exposed nerve elements. A piece of lint soaked in the solution should be applied to the burnt area, and prevented from becoming dry by placing over it a larger piece of oiled paper or jaconet, and moistening the lint with the lotion from time to time. This first dressing should not be disturbed for two or three days. Frequent dressing at first increases the shock. The patient should be put to bed, with hot bottles, and stimulants administered either hypodermically or by the mouth. The picric acid dressing should not be continued after the first two or three days, as by that time it will have accomplished all that it is capable of doing. If the burnt surface is very dirty, or has been covered with oil, it is a good plan to give an anaesthetic, thoroughly cleanse the surface with soap and water, and then apply the picric acid dressing.

The subsequent treatment will be decided by the depth and situation of the burn. In the first two degrees a dry dressing of powder consisting of equal parts of zinc oxide and boracic acid, or of some

simple ointment, should replace the picric acid dressing. In the third degree it will probably be necessary to apply a wet dressing for a few days in order to render the surface clean, after which the dry powder makes an admirable dressing. If the surface is permitted to become sodden, healing is delayed. In the fourth and still more severe degrees the surface will have to become covered by granulation tissue, and great care must be exercised to prevent the absorption of the bacterial toxins as far as possible. Nothing is better than the *continuous bath* treatment, which should always be employed when practicable. This is obviously most easily carried out in the case of the limbs, but it can also be used for the trunk. It must not be forgotten that prolonged immersion sometimes causes a considerable degree of exhaustion, especially in children and old people. It is necessary that a very careful observation should be kept upon the patient during the whole time that he is in the bath, and stimulants administered if necessary. The bath should be kept constantly at a temperature of about 110° F.

As soon as the surface is clean and healthy, skin-grafting should be done, as this very materially hastens healing, while to a large extent it prevents cicatricial contraction. Any tendency to contraction must be carefully corrected by splinting, or the use of weight-and-pulley extension. Adhesions between two surfaces, such as the inner arm and chest, or two fingers, can only result from negligence.

SKIN GRAFTING

It is perhaps not out of place to describe the best method of Thiersch-grafting, because it is not uncommon to see the operation done in a manner which gives the least possible chance for the grafts to take. It is rarely any use laying grafts upon a granulating surface, for although they do sometimes adhere, the chances are largely against their doing so. If 'protective' is laid upon the graft-surface, and the wound is not dressed for several days, the grafts will probably be destroyed by the pyogenic organisms for the growth of which those particular conditions are so eminently favourable.

Operation. The surface is prepared by washing it thoroughly with ether-soap, water, and nailbrush. Then, with a moderately sharp spoon, the jelly-like granulations are to be scraped away until a level is reached where the tissue is firmer and consists of newly-organized fibrous tissue. This surface is then washed thoroughly with sterilized saline solution. No chemical antiseptics are to be used for any part of the operation, because they would kill the delicate protoplasm of the cells both upon the prepared surface and of the grafts. Pressure applied with sterilized gauze whilst the grafts are being cut will efficiently arrest the oozing. The grafts must be cut as thin as possible ; they are of the right thickness when the surface from which they are taken shows a multitude of tiny red points, indicating that the tops of the papillae have been shaved off with the epithelium ; and when they lie flat upon a spatula without tending to curl up at the edges. They are then laid upon the surface and pressed down, so as to leave neither air bubbles nor fluid beneath them. If this is properly done they will adhere at once, and no further oozing

will take place beneath them. The best results are obtained by covering the grafted surface with dry boracic acid powder, and leaving it exposed to the air. *Dryness* is the keynote of success.

CHAPTER III

FRACTURES

I. GENERAL CONSIDERATIONS

Many of the classifications of fractures that have, at one time or another, been adopted, are of little more than academic interest. The one which is of the utmost practical importance is that which distinguishes *compound* from *simple fractures*. Compound fractures are those in which there is a communication between the broken bone and the exterior. They call for immediate and vigorous treatment, and much depends upon the promptness and thoroughness with which this is carried out. The keynote is cleanliness. If asepsis can be secured, or at least if sepsis can be reduced to the point at which any remaining infection can be dealt with by the tissues, the compound fracture will run the same course as a simple one. It is in these cases, perhaps more than in any other class of wounds,

that the indiscriminate use of chemical antiseptics may do harm. If such chemicals avail little when used for the surrounding skin, they can at least do no harm, but the case is very different with the deeper tissues. Organisms which are entangled in the tissues cannot be reached and killed by any chemical solution which will not at the same time kill the far more delicate protoplasm of the tissue cells and phagocytes. Such destruction of the tissues produces a material which forms a favourable nidus for the development of the organisms. On the other hand these tissue cells, if uninjured, are capable of dealing successfully with a certain number of organisms, and they should at least be given the opportunity of so doing.

Treatment of compound fracture

i. Cases in which immediate amputation is necessary.

The indications for this line of treatment are as follows :—

Severe crushes, with extensive comminution of bone and laceration of soft parts.

Extensive involvement of a neighbouring joint.

Obliteration of the arterial supply.

The age and general condition of the patient are also to be taken into consideration. In the young and vigorous an attempt may often be made to save a limb which in the old, the alcoholic, and the subjects of visceral disease, would require primary amputation.

ii. The less severe cases.

The following directions apply more particularly to those in which the wound has been caused by the projection of the bone through the skin.

Operation. The patient having been anaesthetized as soon after the accident as is possible, a preliminary cleansing should be first undertaken. For this purpose the actual wound is covered over with a small piece of gauze, and a wide area of skin around is shaved and thoroughly cleansed with ether-soap and the nailbrush. Attention is next directed to the wound itself, which must be well washed with ether-soap and an abundance of hot water.

In cases where the bone is projecting through

the skin, the wound may have to be enlarged in order to effect its replacement. It is seldom necessary or advisable to remove any portion of it.

The bruised and torn skin-edge must now be cut away with a scalpel, leaving a fresh, clean margin to the wound, which is next washed as clean as possible with hot saline solution, any actually separated pieces of bone being removed, and any badly bruised or lacerated pieces of soft tissue being cut away. Sometimes persistent venous oozing takes place, but this is usually controlled by hot saline solution: failing this, the wound must be plugged with sterile gauze.

Wherever it is possible the wound should be sutured without drainage; but it is often wise to put in the sutures not so closely but that any exudation can escape between them. A plentiful dressing of sterilized gauze and wool is applied. The splint employed should be of such a kind that the wound can be readily inspected with as little disturbance as possible. If at the end of the three or four days the general and local conditions indicate that the

fracture is running an aseptic course, some other form of splint may be substituted.

If, on the other hand, suppuration occurs, the patient is exposed to the dangers, both local and constitutional, attendant upon infective osteomyelitis. Any degree of acuteness of the infective process may be met with, depending upon the nature and virulence of the organisms present, and to a less, though by no means insignificant, extent upon the constitutional condition of the patient. But three main classes of suppurating compound fractures can be recognised :—

(*a*) Those in which the infection is mild, in which little constitutional disturbance occurs, and in which the local signs of inflammation are slight. In these cases it is sufficient merely to open up the wound, apply hot fomentations for a few days and then, immobilizing the fracture upon some splint which allows of ready access to the wound, await the separation of the small sequestrum that may be expected to result.

(*b*) Those in which severe constitutional symptoms occur, the infection spreads beneath the perios-

teum or up the medullary canal, eauses widespread cellulitis, or infeets a neighbouring joint. In sueh cases treatment by free incision and drainage, and bath treatment when praeticable, may yet sueeeed in saving the limb. But if, in spite of all such measures, the fever eontinues and the patient is losing ground, amputation must be performed. This operation is rendered imperative if symptoms of pyaemia begin to manifest themselves.

(*c*) Those in whieh some specifie organism has invaded the wound.

Sueh eases as a rule require immediatc amputation. The treatment will be found under the headings of Emphysematous Gangrene and Tetanus.

Treatment of simple fractures

The treatment is direeted to two main objeets, (1) to ensure firm union of the bone in the best possible position, and (2) to prevent such subsequent disability as might result from wasting of museles, impairment of cireulation, or adhesions in neighbouring joints and tendon sheaths. (1) Reduction of the deformity is best aecomplished under an

anaesthetic. Indeed there are many fractures which cannot be treated satisfactorily without this assistance, whereby not only is pain avoided, but muscular action is overcome. Thus the fracture can be handled freely and firmly, the best position obtained, and the splint or other retentive apparatus applied with ease and accuracy. If there is much bruising or swelling the limb should be placed upon a temporary splint in such a manner as to allow for easy inspection, or for the application of an ice-bag or an evaporating-lotion dressing. After two or three days the swelling will have subsided sufficiently for the use of a more closely fitting splint, such as plaster-of-Paris.

Treatment by operation

There are a few simple fractures which are best treated by an open operation. This is only necessary when either (*a*) some soft structure intervenes between the fragments in such a manner that bony union would be prevented, as in the case of the patella, or (*b*) it is impossible by any manipula-

tion to secure accurate adaptation of the fragments with one another as, for example, sometimes happens when the lower epiphysis of the humerus has been separated from the shaft.

(2) The prevention of subsequent disabilities is attained by (*a*) proper adjustment of the retentive apparatus, so that undue pressure is avoided at any particular spot, (*b*) the avoidance of too tight bandaging, which is responsible for disturbances of circulation and especially for the condition known as *ischaemic paralysis*, and (*c*) the early use of massage, and passive movements of neighbouring joints and tendons.

Treatment by massage

It has been claimed by some surgeons that better results are obtained in certain fractures if splints are entirely abandoned, the part merely being kept at rest between sandbags, and massage applied daily from the commencement. Such a method, whilst possessing many merits, has the drawback of impracticability, especially as regards hospital patients, children, and the timid. The practical method

which yields the best results lies in the intelligent combination of splinting with early massage, namely, absolute fixation for a few days until muscular spasm has passed off and the risk of fresh displacement minimised, followed by daily massage and passive movements, the limb in the intervals being replaced in the splints.

Treatment of special fractures

It is beyond the scope of this work to follow out in any detail the treatment of individual fractures. Those of certain regions, namely, the skull, spine, pelvis, and ribs, the interest and treatment of which depend so largely upon concomitant injury to the organs which they protect, are dealt with in the sections relating to those regions. But there are a few special fractures which require separate mention in order to emphasize those particular points upon which their successful treatment depends.

(a) *Separation of epiphyses*

This lesion involves a fracture through the epiphyseal plate of cartilage, and, if displacement

has occurred, rupture of the periosteum as well. It may here be mentioned that the line of fracture usually traverses that layer of newly-formed bone which has most recently been added to the shaft, and not the actual cartilaginous disc. For this reason it is rare for the separation of an epiphysis to be followed by arrest of growth of the bone, provided that the fragments have been accurately replaced. The importance of this point is so great that in any case in which accurate adjustment cannot be effected by manipulation, the fracture should be exposed by operation, and the parts replaced in their proper position. No wiring or pegging is necessary, because there is no tendency to fresh displacement that cannot be overcome by suitable splinting.

(b) *Fractures involving joints*

There being in these cases a great tendency to the formation of adhesions within the joint, and consequent stiffness, it is of more than ordinary importance to see that massage and passive movements are begun early.

(c) *Some common individual fractures*

i. *Patella.* It is now generally recognised that all cases of this accident attended by separation of the fragments should be subjected to the operation of wiring, unless there is some definite contra-indication, such as age or the presence of visceral disease. Many surgeons prefer to wait for a week or ten days before operating, in order to allow time for the effusion in the knee-joint to subside. There is, however, far less tendency to stiffness if the operation is performed immediately after the accident, when the blood can be removed whilst still unclotted, or at least before the clots have adhered firmly to the synovial membrane. Moreover, the traumatic synovitis is thereby lessened, and the period of recovery considerably shortened.

Operation. A vertical incision, some three inches long, is made with its centre over the line of fracture and passes at once down to the bone. With scissors and forceps the torn quadriceps expansion intervening between the fragments is removed, and a wire of silver or silvered copper is passed vertically between the fragments, care being taken that the

articular cartilage is not traversed. The blood and clot are removed from the joint by a rapid stream of warm, sterilized saline solution, and the fragments drawn together. The wires are then twisted together and their ends cut off, leaving at least half an inch of twist to be turned upwards, and hammered down flush with the surface of the patella. The wound having been closed, an abundant dressing of gauze and woodwool tissue is applied. No splint is required. Gentle passive movements and massage should be commenced at the end of a week.

ii. *Olecranon.* If the patient is young and healthy, and there is a definite separation between the bones, the operation of wiring should be performed in a manner precisely similar to that described for the patella. If this is not done the fibrous tissue that will form the bond of union is liable to stretch and cause weakness of the elbow. When no operation is to be performed, an anterior, straight splint is applied to arm and forearm, a small pad being placed at the bend of the elbow. The position so obtained is one of very slight flexion.

iii. *Colles' fracture.* The main points to remember

are (*a*) that the displacement is not due to muscular action, and therefore does not tend to recur after reduction, and (*b*) that there is always some damage to the sheaths of the tendons which pass so closely to the lower end of the radius, thereby calling for special treatment in order to prevent stiffness.

If the fracture is impacted, an anaesthetic must be given, and the deformity reduced in the same manner as if no impaction is present.

The hand should be placed upon a Carr's splint, over the crossbar of which the patient is to be encouraged to exercise his fingers from the first. Each day the splint should be removed and massage applied.

iv. *Pott's fracture.* This is really a dislocation of the foot outwards and backwards at the ankle-joint, complicated with fracture of the lower end of the fibular shaft, and rupture of the internal lateral ligament or fracture of the tip of the internal malleolus. An anaesthetic is required for its reduction. This having been effected, either at once if the swelling is slight, or in two or three days if there is very much effusion, the limb should be

encased in a plaster-of-Paris splint including the foot and the knee-joint. The foot should be placed in as inverted a position as possible. In ten days' time the splint is removed, the limb placed between sandbags, and daily massage and movements of the ankle-joint begun.

CHAPTER IV

ACUTE INFECTIVE DISEASES

Certain diseases due to pyogenic and other infective micro-organisms come within the province of the surgeon, and many by virtue either of the acuteness of their symptoms, or of the destruction of tissue which they may occasion, can rightly be regarded as surgical emergencies. Such conditions will be considered under the following headings :

I. THOSE DUE TO THE COMMON PYOGENIC MICRO-ORGANISMS

(a) *Abscess*

All acute abscesses require immediate treatment wherever they occur. Those in special regions calling for special treatment, such as retropharyngeal, intracranial, and intra-abdominal abscesses,

are dealt with in other chapters. It is only necessary here to mention a few points in connexion with abscesses in general.

(i) A common fault in their treatment is too small an incision. No abscess is efficiently opened unless at least one finger can be introduced into its cavity, nor properly drained by a tube of less than the size of the little finger. In most situations these conditions are capable of fulfilment ; in a few they are not, and it is these circumstances that troublesome sinuses are apt to form.

(ii) Regard must be had to the anatomical position of the abscess. Again, in most cases, the circumstances are such as to allow of a very free opening, as in the case of the breast or the ischio-rectal fossa. In some, as in deeply-placed abscesses of the neck, the anatomical conditions render a free incision impossible. In such situations the method known as Hilton's is to be employed, and is as follows. An incision of reasonable length, neither timid nor overbold, is made through both skin and deep fascia. A pair of sinus forceps is then taken and gently insinuated into the depths

of the tissues until pus is reached, when the blades are to be separated so as to enlarge the track by a process of stretching. If possible, the finger should be thrust along the track after withdrawal of the forceps, so as to render it possible to use a drainage tube of adequate calibre.

(iii) The drainage tube must not be retained too long in the wound. Most abscesses do not (to employ a well-known phrase) ' heal from the bottom,' but rather by ' union of granulations ' assisted by the falling in of the walls of the cavity. Where the walls of the cavity are rigid, and unable to collapse, the wound must be plugged frequently so as to encourage ' healing from the bottom ' ; but in other cases a tube or plug may actually prevent healing. A case in point is that of a child with an abscess of the neck. A tube had been diligently, and with some trouble, kept in the wound for six weeks, and the condition presented was that of an unhealthy sinus, with prominent granulations around its margin, and surrounded by a wide area of brawny infiltration. After leaving out the tube the wound healed soundly in a few days.

(b) *Cellulitis*

If a case of an acute abscess is urgent, that of a spreading cellulitis is still more so. The diagnosis is usually simple, the only condition likely to be mistaken for it being cutaneous erysipelas. The following are the chief points of difference. In erysipelas the constitutional symptoms are more severe at the outset, the temperature rising rapidly to 103° or 104° F. ; the skin itself rather than the subcutaneous tissue is oedematous and tense : the redness is bright and uniform, and often presents a definite margin ; and the smooth, shiny surface almost always presents a number of vesicles of varying size.

Another condition which may give rise to difficulty in diagnosis is acute infective periostitis. In a child with brawny redness over the tibia, for example, it may not be easy to say whether the inflammatory exudate is subcutaneous or subperiosteal. In the former case, however, the constitutional symptoms are not so severe, the onset is more gradual, and there is usually some recognisable focus of infection.

Treatment. In cellulitis, incisions must be made without waiting for the appearance of pus as a recognisable collection. And the incisions must be of adequate extent. If the area involved is extensive, it is a good plan to make a number of incisions, each two or three inches in length, parallel with one another, and leaving bridges of skin between them. The haemorrhage is often free, so that the wounds require plugging with gauze strips for the first dressing. After twelve hours these plugs can be left out altogether, and the part treated with hot fomentations frequently changed. If a limb is involved it may with advantage be immersed in a boracic bath for several hours a day. It may not be out of place in this connexion to point out that it is of little use to throw solid boracic acid into a large quantity of water, because the powder simply floats on the surface as an inert scum. The proper way is first to mix the powder in a small quantity of water until a creamy fluid is obtained, in much the same way as domestic starch-paste is made, and then to dissolve this in the bath. Cellulitis of the neck, known as Ludwig's

angina, is described in the chapter dealing with respiratory obstruction.

(c) *Carbuncle*

This name is given to a condition of gangrene affecting the skin and subcutaneous tissues in a situation where the tissue is dense and the blood-supply poor. It is attended with much pain and often by severe constitutional symptoms. The glycosuria which is not infrequently present may be a contributing factor in the production of the disease; but it must be remembered, in giving a prognosis, that glycosuria sometimes occurs in consequence of the disease, as it does also in some other forms of gangrene, and may, therefore, be only transitory.

Treatment. If the carbuncle is of moderate size, and in a convenient situation, excision is the best treatment. By this means the whole disease is removed as effectually as by an amputation in gangrene of the foot: the pain is at once relieved, and the toxic symptoms are abated. The bare area may subsequently be grafted. If this line of treat-

ment is not possible, free incisions are to be made into the tense tissues, and frequent hot fomentations applied. The slough may be snipped away with scissors, but no attempt should be made to remove it completely with a curette. It must be allowed to separate naturally.

(d) *Whitlow*

The pus of a whitlow may be in one of several situations. It may be subcutaneous, subperiosteal, or intrathecal. The treatment of the first two requires no special description; but the thecal whitlow, threatening as it does the function of a finger, or even of the whole hand, is of the utmost importance.

Perhaps the greatest difficulty with which the surgeon may be confronted is that of deciding whether the pus is in the tendon sheath or outside of it. Especially is this the case when, as sometimes happens, a perithecal inflammation is accompanied by an effusion of serous fluid into the tendon sheath. If there is pus there already, immediate incision offers the only prospect of saving the tendon. If not, an incision through infected tissues

is almost certain to infect the synovial membrane. In case of doubt it is best to incise down to, but not into the sheath, and, applying hot fomentations, carefully watch the course of events during the next twelve hours or so. If no improvement has occurred by that time, the sheath must be opened and drained.

After-treatment. The hand should be immersed in a boracic bath for several hours a day, and in the intervals of bath treatment, hot fomentations should be frequently applied.

The patient should be encouraged to begin moving the fingers gently two or three days after the operation, in order to prevent stiffness; as healing proceeds the movements should become more frequent and extensive. If healing is delayed and the movements are much impaired, the probability is that a tendon has sloughed, and will require removal later.

(e) *Acute bone disease*

'Acute necrosis,' whether commencing as a periostitis, osteomyelitis, or epiphysitis, causes the same train of symptoms and calls for the same

line of treatment. The dangers of delay are both general and local; the former including septicaemia and pyaemia, and the latter extensive necrosis, separation of epiphyses, and involvement of joints and other neighbouring structures. There should, therefore, be no hesitation in operating at the earliest possible moment.

Operation. The incision must be placed over the region of greatest swelling, and in the case of a superficial bone should at once be made down to the bone. In some situations, as, for example, the dorsum ilii, it is necessary to plan the incision so as to be able to divide the intervening muscles in the direction of their fibres.

The question often arises as to whether the bone itself should be gouged into, but this is rarely necessary because usually the whole thickness of the bone being dead, there is no circulation within it whereby toxins could be absorbed. If, however, the constitutional symptoms do not abate after the first operation, and there is no other lesion to account for their continuation, it is then wise to open up the bone at a second operation.

When the pus is situated in the neighbourhood of a joint, and the joint itself is not involved, great care must be taken not to open into the synovial cavity. When the bone is deeply placed, large drainage tubes must be employed, but when it is superficial, as in the tibia, there is no occasion to use them : the cavity should then be lightly packed with strips of gauze. A culture from the pus should always be taken at the time of operation.

After-treatment. This must be directed to maintaining the patient's strength, and to limiting absorption from the wound. Spreading of the infective process and residual abscesses must be watched for, and dealt with directly if they should occur. In severe cases the effect of the appropriate antitoxin may be tried with advantage. If in spite of everything no improvement in the general condition is obtained, and especially if symptoms of pyaemia occur, amputation must be resorted to.

(f) *Acute infective arthritis*

If a patient has sustained a penetrating wound of a joint only a short time before he is seen, the

following line of treatment should be carried out. The wound and surrounding skin are to be thoroughly cleansed, an antiseptic dressing applied, and the limb placed upon a splint. A careful watch is kept upon both the local and general condition. If there is much pain and effusion into the joint, and the temperature rises up to or beyond 101° F., the joint should be opened, and a culture having been taken from the exudate, thoroughly washed out with sterile saline solution, and closed. By this means sometimes, even though pyogenic organisms are found in the fluid, the disease can be arrested, and recovery with normal movement secured. If, however, the symptoms show no improvement, the stitches can be removed and drainage tubes inserted. A knowledge of the bacteriology of the fluid will enable the appropriate antitoxin to be used.

In cases which are too advanced for the treatment just indicated, it is a good plan to try continuous irrigation. As the knee is the joint by far the most frequently affected, the following description will apply to it, but can be modified to suit other joints.

An incision is made on either side of the patella, and a piece of wide drainage tube, which should only just project into the joint, secured in each by means of a stitch. The limb, placed slightly flexed upon a Macintyre splint covered with macintosh, is then placed over a large leg bath ; one of the tubes is then connected to a double Berkfield filter in such a manner that a rapid stream of water, kept constantly at a temperature of 105° F., can flow into the joint, out of the other drainage tube, and into the bath, whence it is carried away by another tube connected with the tap at the bottom of the bath. This treatment can be kept up continuously for two or three days if necessary, but requires the undivided attention of the nurse.

Should this treatment be unavailing, there remains another and more heroic measure which is as follows. An incision is made, extending from one condyle to the other, and traversing the patellar ligament. The flap thus formed is turned upwards, the knee acutely flexed, and packed lightly with gauze which is to be changed frequently. In a few days, if the constitutional symptoms are abating,

and the local condition improving, the leg is gradually straightened out, and the flap turned down and secured in place by a few sutures. If the ankylosis which must ensue takes place in a flexed position, subsequent cuneiform osteotomy may be required to correct the deformity.

If, in spite of all treatment, the disease progresses, or if pyaemia supervenes, then amputation must be performed.

II. TETANUS

In this disease so much depends upon prompt treatment that its early recognition is a matter of the first importance. The diagnosis usually presents little difficulty in the presence of a dirty wound received several days before the onset of the symptoms. But sometimes no point of infection can be found, and the symptoms may be anomalous, in which event the diagnosis may be difficult. *Trismus* from the irritation of unerupted or carious teeth, and '*stiff neck*' of a rheumatic nature, must be borne in mind as the two conditions most apt to be mistaken for tetanus. But if the history and the

result of an examination are carefully considered, there should be no difficulty in arriving at a correct diagnosis. *Strychnine poisoning* will be recognised by the history, by the early involvement of the limbs, and by the fact that the muscles are completely flaccid between the spasms, whilst in tetanus they are never completely relaxed.

Treatment. The focus of infection must first be removed either by amputation or excision. Whilst the patient is still under the anaesthetic a dose of antitetanic serum should be administered. No precise rule can be laid down as to the quantity, because the various preparations are of different strengths, but it is safe to say that the dose should be large. Moreover, it is necessary to be sure that the serum used should be freshly prepared. The mode of administration appears to be of little moment, and perhaps subcutaneous injection is as efficacious as any. But certain cases seem to point to the intrathecal as the best method. The operation is performed as follows. The patient lying semi-prone, the trunk is flexed as much as possible, and a long antitoxin needle is thrust upwards and

slightly inwards half an inch from the mid-line at the level of the interval between the second and third lumbar spines. With a little manipulation it can be made to pass between the laminae and enter the spinal theca, when cerebro-spinal fluid will begin to escape. The serum is then slowly injected along the needle with an ordinary antitoxin syringe.

After-treatment. The patient must be put to bed in a quiet and darkened room. Large doses of chloral and bromide of potassium, 20 to 30 grains of each, are given every four hours, and if that fails to control the spasms, chloroform should be continuously administered through a Junker's inhaler. If retention of urine is present, the bladder must be emptied by catheter at regular intervals. Food, too, may have to be administered by means of the stomach tube. As both of these manipulations are apt to produce convulsions, they are best carried out under chloroform anaesthesia : at the same time further injections of serum may be made into the spinal theca or, if preferred, subcutaneously.

III. EMPHYSEMATOUS GANGRENE

The recognition of this disease is a matter of no great difficulty. It is apt to occur in cases of extensive lacerated wound, or of compound fracture, where road dirt has been ground into the wound. In from twenty-four to forty-eight hours the patient's temperature rises to from 102° to 105° F., the symptoms of an acute toxaemia rapidly become evident, and the infected tissues become oedematous and discoloured, whilst gas crepitation can be felt in and beyond the oedematous area. Film preparations taken from the exudate of the wound, which is usually clear, yellow, and abundant, may show the presence of the B. Aerogenes Capsulatus, the commonest cause of the disease in man.

Treatment. In spite of much that has been said, it is not always necessary to perform amputation at a great distance from the focus of infection : in fact the situation sometimes renders amputation impossible, as, for example, in a case affecting the chest-wall. However, when amputation is possible, it is certainly safest to adopt that line of treatment : it should be done above the area of discoloration

of the skin, but not necessarily above the oedematous area. No stitches should be put in, but the flaps left widely open and packed with gauze soaked in peroxide of hydrogen. During the next twenty-four hours the gauze should be frequently wetted with the peroxide solution. If by this means the disease has been arrested, the flaps may be adjusted with a few sutures a day or two later. In cases where amputation is impracticable, very free incisions should be made into the oedematous tissues and a dressing of peroxide of hydrogen frequently applied. This solution is recommended because the B. Aerogenes Capsulatus cannot flourish in the presence of oxygen, which is given off when the hydrogen peroxide comes into contact with the tissues.

IV. ANTHRAX

The malignant pustule which arises at the point of inoculation of the B. Anthracis may be closely simulated by a staphylococcic infection, or by an accidental vaccination pustule. The former may only be recognisable by bacteriological examination,

but the latter can usually be diagnosed by the history of the case. In case of doubt, films should be prepared from the fluid of the vesicles, when the bacilli can be recognised with tolerable ease if the case is one of anthrax.

Treatment. The focus of infection should be freely excised and the raw surface of the wound painted with pure carbolic acid, after which frequent antiseptic fomentations should be applied.

V. CANCRUM ORIS

This disease, occurring usually in unhealthy children, is to be recognised by the presence upon cheek or lip of a central dark area of necrosis surrounded by a wide area of brawny oedema, together with constitutional symptoms of a very severe degree. It is not to be confused with gangrenous stomatitis, in which the mucous membrane is extensively ulcerated, the oedema comparatively slight, and the constitutional symptoms are less severe.

Treatment. The patient must be anaesthetised, and the gangrenous area widely cut away with

scissors. The limit of excision is indicated when tissues beyond the area of stasis are reached, as shown by the capillary bleeding that occurs. The whole surface of the wound is then painted over with strong nitric acid, and left open.

After-treatment. The mouth and wound should be frequently syringed with some non-poisonous antiseptic, such as formalin (1 in 1000). At the same time the patient's strength is to be supported by food and stimulants. If recovery takes place, a plastic operation may be necessary at a later date.

CHAPTER V

ACUTE ABDOMINAL DISEASES

It is not within the scope of this work to discuss in detail the differential diagnosis of the many and varied lesions which come into the category of acute abdominal disease, as that term is understood by the surgeon. Whilst slovenliness is to be deprecated, yet it must be admitted that in some cases an accurate diagnosis is not a matter of vital importance, and in many it is only obtainable by operation. For example, a diagnosis of acute intestinal obstruction having been made, it is immaterial whether the cause is an internal hernia or a Meckel's diverticulum. The most important considerations are when to operate, how to deal with any condition which may be found, and upon what observations a prognosis may be based.

In some cases an accurate diagnosis may be arrived at with reasonable certainty, but there

are very many instances in which it is impossible to be at all sure of the lesion present. Nor is the reason far to seek. Whether the initial lesion is a perforation, an obstruction, or the torsion of an ovarian pedicle, the fatal issue, if the case be untreated, will be due to the same cause, namely, peritonitis. The subject of intestinal obstruction does not die because the flow of the intestinal contents is arrested, but because the vitality of the intestinal wall is interfered with and permits the passage of bacteria from the intestine to the peritoneal cavity. There are, it is true, cases in which death is due to causes other than peritonitis. For example, the perforation of a gastric ulcer has been known to cause death almost suddenly from shock ; and a ruptured tubal pregnancy may rapidly bring about a fatal issue from the haemorrhage alone. But in the great majority of cases the peritoneal infection which will sooner or later result from any acute abdominal lesion is the factor of vital importance. It is, therefore, the prevention and treatment of peritonitis which is the primary object of surgical interference.

CONDITIONS SIMULATING ACUTE ABDOMINAL DISEASE

It must be remembered that there are certain acute conditions which, if unrecognised, may lead to the performance of an unnecessary operation. Such are *lead poisoning*, which may be mistaken for intestinal obstruction; *diarrhoea* with collapse, in children, which may be mistaken for intussusception; *renal* or *biliary colic*; *basal pneumonia*; and *acute colitis*. Against such deceptive conditions the surgeon should always be upon his guard, but it must be admitted that the majority of errors are those of procrastination, and that whilst an unnecessary laparotomy is an event to be deplored, yet over-activity is far less likely to be a cause for regret than timidity.

CONDITIONS WHICH CALL FOR IMMEDIATE OPERATION

These may be placed under five general headings:

(1) Haemorrhage.

(2) Intestinal obstruction.

(3) Gastric and intestinal perforation.

(4) Appendicitis.

(5) Peritonitis from other causes.

(1) Haemorrhage

Intraperitoneal haemorrhage resulting from traumatism is considered in the chapter dealing with abdominal injuries. That which results from disease such as aneurysm or ulceration into a large vessel, rarely if ever comes within the possibility of surgical treatment. The only condition which does come within the scope of surgery is the rupture of a tubal pregnancy. The haemorrhage from this cause may be of any degree from a leakage so slow that a localised haematocele may result without there ever being any alarming symptoms, up to an outpouring of blood so rapid as to cause death in a very short time. It is only the more severe cases with which we are here concerned. The signs and symptoms usually leave no room for doubt as to the diagnosis. A woman who has missed a menstrual period is suddenly seized with severe abdominal pain and collapse. The patient is blanched ; the pulse is rapid and accelerating ; there is severe pain in the lower part of the abdomen with some rigidity and perhaps vomiting ; shifting

dullness may be found in the flanks, and vaginal examination may reveal the presence of a swelling alongside of an enlarged uterus, from the cavity of which a little dark blood is escaping. When these symptoms are present, even if they are only of slight degree, operation should at once be proceeded with, because, if neglected, the patient is exposed to the risk of a sudden increase in the rapidity of the haemorrhage, as well as to the dangers of peritonitis. Whenever haemorrhage takes place into the peritoneal cavity the effused blood very rapidly becomes infected with a *staphylococcus albus*.

Operation. The abdomen should be opened by separating the fibres of the rectus muscle below the umbilicus on one side or other of the mid-line. The ruptured Fallopian tube is then brought up out of the pelvis, ligatured with strong silk, and removed. All blood and clot are rapidly removed, either by means of dry sponges or by irrigation with normal saline solution, and the abdomen closed. Intra-venous saline infusion may be required during the operation, but the patient should never be kept in the theatre for the purpose after the

operation is completed. It is better to get her back to bed with hot bottles, and to keep the foot of the bed raised. This position, in addition to combating faintness from loss of blood, also allows fluid to be administered readily per rectum. Very often there is a rise of temperature for a few days after operation, but this need occasion no anxiety.

(2) Intestinal Obstruction

The clinical picture presented by the victim of intestinal obstruction is usually characteristic. There has been the sudden onset of acute abdominal pain, with or without a history of previous similar but less severe attacks, or of chronic constipation. The vomiting is characteristic ; at first only stomach contents, it rapidly becomes stercoraceous, and is suddenly and forcibly ejected at varying intervals and usually in large quantities. It is what is sometimes known as ' projectile ' vomiting. The pulse becomes rapid, the abdomen distended and tympanitic, the face pale and anxious, and the eyes sunken. Such a patient is in urgent need of relief by operation, but the abdomen should never be

opened before two examinations have been made ; firstly, examination of the hernial regions to exclude the possibility of strangulated hernia (and it should be especially borne in mind that a small femoral hernia in a fat woman may be very easily overlooked), and secondly, a digital examination of the rectum to exclude the possibility of the obstruction being due to carcinoma or other stricture.

Having eliminated strangulated hernia and rectal stricture, the cause of the obstruction becomes in most cases a matter of speculation rather than of accurate diagnosis. The only variety of obstruction which can be diagnosed with any reasonable degree of certainty is intussusception. Strangulated hernia is dealt with in a separate section. If rectal stricture is present the operation of colotomy should be proceeded with at once.

Colotomy. Before proceeding to open the colon an examination of the growth is to be made with a view to determining whether it is capable of removal at a subsequent operation. If it is inoperable, the opening should be made in the pelvic colon, as being the most convenient position for an

artificial anus; if a subsequent operation is contemplated, the transverse colon should be opened, to prevent the difficulties that might arise later from anchoring the intestine too near the site of excision.

The *operation* is performed in the following manner. A small incision is made through the rectus sheath, splitting the muscle in the direction of its fibres. The distended colon is brought up to the surface and packed round with gauze strips to isolate it from the peritoneal cavity. It is then clamped on either side of the proposed opening. An incision is next made into the bowel, sufficiently large to admit the introduction of a large Paul's tube, and a purse-string suture passed round its edge. When the tube has been inserted, this suture is drawn tight and tied in the groove upon the tube provided for the purpose. The bowel is now sutured to the edge of the rectus sheath, and the rest of the abdominal incision closed.

If the colotomy is to be permanent, a simpler method may be adopted. The loop having been drawn out of the wound, a glass rod is passed

beneath it, through its mesentery, and resting at either end upon the surface of the abdomen. Then, if the symptoms are urgent, a Paul's tube may be tied in as described above, or if the symptoms are not so acute, the bowel may be opened a few days later by dividing it transversely upon the glass rod.

Intussusception. This form of obstruction is almost confined to infancy. It does sometimes occur in older children and even in adults, but the majority of the patients are under twelve months of age. The onset is sudden, accompanied by abdominal pain, vomiting, and the passage of bloody mucus *per anum.* On examination the child is usually placid, and the abdomen flaccid, but looking pale and sunken about the eyes. Abdominal palpation will generally reveal a tumour of varying size. If the symptoms point strongly to intussusception, and no tumour can be felt, chloroform must be administered in order to assist the examination. The only cases in which the tumour is likely to escape detection are those in which it is small and hidden beneath the liver. Rectal examination may detect the apex of the intussuseeption.

Treatment. A few cases have undoubtedly been successfully treated by the old methods of manipulation and rectal irrigation; but it must be admitted that such methods are extremely uncertain, and that their employment is likely to add to the shock and to waste valuable time. If the facilities for immediate operation are not at hand, and some time must necessarily elapse before it can be undertaken, there is no harm in trying the effect of gentle irrigation of the bowel. This is done as follows :—

The child lies on the back with the pelvis raised, and a tube, connected with a funnel, is introduced into the rectum. The funnel must not be elevated more than two feet above the patient lest a dangerous degree of pressure should be obtained. Warm water is then allowed to run into the bowel, and it may be found that the tumour gradually becomes reduced in size. This is particularly likely to happen if the tumour is a large one and the symptoms are not very acute. Generally speaking, it is not difficult to reduce the greater part of the intussusception by this means, but it is very unlikely

that the whole will be so reduced. Moreover, the disappearance of the greater part of the tumour may lead to the erroneous supposition that complete reduction has been effected. It may be said, therefore, that this method should only be employed either when operation is unavoidably delayed for some hours, or as a deliberate preliminary to operation with a view to reducing the size of the tumour, and so shortening the actual time of operation. For this is one of the few operations in which rapidity of manipulation is of real advantage. Infants bear abdominal operations very badly, and the more quickly the operation can be performed the better are the chances of recovery. The operation has been done in three minutes, but perhaps ten minutes may be taken as an average time commonly required.

Operation. An incision large enough to admit two fingers is made through the abdominal wall by separating the fibres of the right rectus muscle below the umbilicus. The tumour is felt, and is then gently pushed along the direction of the colon towards the caecum. If the tumour has reached

the iliac colon, the direction will be first upwards towards the spleen, then across the abdomen towards the hepatic flexure, and lastly downwards along the ascending colon towards the right iliac fossa. As a rule this part of the operation will be accomplished with ease. The caecum and termination of the ileum should now be brought out of the wound, and the remainder of the reduction effected with the aid of vision, otherwise a small portion of the intussusception may remain unreduced. The abdomen is next closed by means of a few strong sutures, which include the whole thickness of the abdominal wall. It is doubtful whether the extra time required for suturing in layers is repaid by the results. The sutures should not be removed until the tenth day, because it sometimes happens that union is delayed and the wound may burst open if the stitches are removed too soon.

If the intussusception proves to be irreducible either wholly or in part, or is gangrenous, the case assumes a very grave aspect. Recovery after resection of bowel in young children is an event of the rarest occurrence. Probably the best chance

is given by bringing the tumour out of the wound, packing it round with gauze, and leaving it there, to be resected later by an extra-peritoneal operation, should the child survive. If the general condition of the patient is fairly good, the tumour may be resected, and a Paul's tube tied into each end of the cut bowel, anastomosis being done later. In older children, and in adults, these means offer a fair prospect of success, but in infants the cases are almost hopeless.

It is perhaps not too much to say that, with the exception of strangulated hernia, rectal tumours, and intussusception, it is extremely difficult to diagnose with any degree of precision the cause or situation of an intestinal obstruction. Certain facts in the previous history ; the mode of onset of the illness ; the age and general condition of the patient ; and the features presented by the abdomen on examination, are all factors to be borne in mind in attempting to make a diagnosis. For example, a previously healthy young man is suddenly seized with obstructive symptoms of an extremely acute character—faeculent vomiting is early and persis-

tent—abdominal distension is not a marked feature : the case is possibly one of an acute obstruction high up in the small intestine, such as would be produced by a band or an internal hernia. Again, an elderly man who has for some months suffered from chronic constipation and loss of weight becomes somewhat rapidly worse—vomiting is neither early nor distressing—intestinal distension is a marked feature ; the case is likely to be one of obstruction by growth in the large bowel.

Operation for intestinal obstruction of uncertain origin. If the case is of the most acute character, and shock is a marked feature, the question arises whether one ought to wait, or proceed to operate at once. It is a question which can only be decided by the application of experience to the individual case. It is true that occasionally a patient is too ill to take an anaesthetic, and that by the application of warmth, the administration of stimulants, and intravenous infusion, the general condition may be considerably improved : yet it is just in such a case as this that the risk of gangrene of the bowel is greatest and delay is to be avoided. Moreover,

such a patient may improve considerably on the administration of the anaesthetic. It may be said, therefore, that only in the most exceptional circumstances is operation to be delayed.

If the cause of the obstruction is uncertain, the best method of opening the abdomen is to split the right rectus muscle in the direction of its fibres, at about the level of the umbilicus. There are few intra-abdominal conditions which cannot be dealt with through this incision. Having opened the peritoneum, the distended intestine is to be followed in a downward direction until the site of the obstruction is reached. There are several methods whereby the direction of the small intestine can be ascertained, but the simplest and most generally serviceable is the following. The operator, standing on the patient's right side, takes a coil of intestine in the left hand, and pulls it out of the wound until the mesentery is put on the stretch. The right forefinger is now passed along the lower or left surface of the mesentery until the spine is reached, when it will readily determine by the direction of the root of the mesentery the direction

of the attached bowel. If the colon is distended there is of course no need to trouble about the small gut, as the obstruction must then be in the colon itself below the distended portion. The site of the obstruction having been reached, any of the following conditions may be discovered. The method of dealing with each will be described under its own heading.

Carcinoma of the intestine. The treatment of this condition may be discussed under two headings :—

(*a*) The growth is not capable of being removed, or metastases are so evident as to render its removal useless. The temptation will be to perform a short-circuiting operation by means of a lateral anastomosis, but this should in almost every case be avoided. The reasons for this are overwhelming. The distended, inflamed, and softened gut holds stitches with difficulty, and healing does not readily occur. Moreover, the contents of obstructed intestine contain varieties of the colon bacillus in a state of exalted virulence, and the peritoneum may readily be infected during an anastomotic operation. It is well known that leakage is far more likely

to occur from an anastomosis performed upon obstructed than upon normal intestine.

If anastomosis is performed during acute intestinal obstruction, it must be remembered that a very grave additional risk is incurred. The proper mode of procedure then, in most cases, is to bring out the distended gut immediately above the growth, pack it off from the peritoneal cavity, open it, and tie in a Paul's tube laterally.

This enterostomy opening, which is almost always the colon or lower ileum, may remain permanently or, if the condition of the patient warrants it, a short-circuiting operation, with closure of the artificial anus, may be performed later, when the intestines have resumed their normal condition. If the tumour should be situated in the jejunum, the risks of an immediate anastomosis are perhaps to be preferred to the horrible condition which is apt to result from an artificial anus placed high up in the small intestine.

(*b*) The growth is capable of removal.

The danger already discussed of anastomotic operation upon obstructed intestine must be borne

in mind in deciding how to deal with such a case. The ideal operation of resection and immediate anastomosis, which would be the proper course to pursue in a state of intestinal repose, is not to be thought of during acute obstruction, and the operator should at once make up his mind that the operation cannot be completed at one stage. There are several methods available :—

(i) To perform colotomy at some distance above the growth ; to resect and anastomose at a second operation ; and to close the artificial anus in a third operation.

(ii) To bring the growth outside the abdomen, suture the loop of intestine in this position, and tie a Paul's tube into the gut just above the tumour, leaving the resection to be performed later.

(iii) To resect the growth and tie a Paul's tube into each end of the divided intestine, leaving anastomosis and closure of the faecal fistula to be done at a second operation.

The chief guide to the selection of one or another of these methods is the condition of the patient.

Strangulation by bands, and internal hernia. These

cases are sometimes the most acute, sometimes the mildest form of intestinal obstruction, the severity of the case depending upon the tightness of the band and the completeness with which the vascularity of the ensnared bowel is interfered with. In this class are included strangulation of a Meckel's diverticulum ; strangulation of a coil of bowel by a Meckel's diverticulum ; and strangulation by an adherent vermiform appendix. On discovering that one or other of these conditions is the obstructing agent, the first thing to do is to release the ensnared bowel, either by division of the band, or removal of an appendix or a Meckel's diverticulum, if either of those structures is causing the obstruction. The obstructed bowel is next carefully observed, in order to determine whether it is viable or not. This point is discussed in the chapter on Strangulated Hernia. If the bowel is viable, it should be washed over with saline solution, returned into the abdomen and the wound closed. If it is obviously gangrenous, or if the probability of its recovery is in doubt, it must be resected.

It has already been stated that intestinal

anastomosis during acute obstruction is far more likely to fail than during a period of intestinal repose. But occasionally the risk must be taken. If the gangrenous bowel is low down on the ileum, the best plan is to resect, tie a Paul's tube into each end, and perform anastomosis a week or so later. But if the lesion is high up, in the jejunum, the risks of making an artificial anus are as great as those of immediate anastomosis, partly because the patient will rapidly lose ground owing to malnutrition, partly because the skin around the wound is very apt to become digested, and to render the subsequent operation both difficult and dangerous. One point of importance is to be insisted upon here. If immediate anastomosis is to be undertaken, the length of bowel resected must be much greater than if a two-stage operation is decided upon, in order that the suturing may be done at a considerable distance from the site of strangulation, and therefore through more healthy intestine.

It is not always possible to be certain at what part of the small intestine the gangrenous bowel

is situated, but if there is good reason to believe that it is situated fairly low down in the ileum the two-stage operation is to be preferred.

Obstruction by adhesions. Many of these cases come under the last heading, but when the adhesion produces a kinking, as opposed to a band strangulation, the pathology of the condition is completely different. In the class of cases just considered, the bowel is not only obstructed, but is in some portion of its length subjected to the risk of gangrene from interference with its vascular system.

In many cases it happens that the gut can be liberated from the structure to which it is adherent, be it another coil of bowel, one of the other viscera, or a mesenteric gland. If such liberation can be effected, the patch on the bowel, devoid of peritoneum, should be sequestrated by means of Lembert sutures, in order if possible to prevent the adhesions re-forming. But frequently the extent and density of the adhesions render such a course impracticable. It may, therefore, only be possible to effect a short circuit by a lateral anastomosis between coils of intestine above and below the

obstruction. When this is the case the prognosis must be regarded as serious, for the reason already discussed.

Obstruction by a gall-stone. There are several methods by which a gall-stone may cause obstruction. A large stone may do so by actually blocking the intestinal lumen, but a stone far too small to cause acute symptoms in this manner may do so by producing an acute kink, or even a volvulus. The site of the obstruction is the small intestine, most frequently the ileum. In dealing with such an accident there are two courses open, either (a) to open the intestine, remove the stone, and suture the openings, or (b) to manipulate the stone along the small gut into the colon, and leave it to be evacuated thence by natural means. The latter method is to be preferred when practicable, that is, where the stone is of small size, not firmly fixed, and within a reasonable distance of the ileocaecal valve. The objection to the first method is the undoubted risk of incising and suturing intestine which is in a pathological state, and in which the organisms have attained a high degree of virulence.

Volvulus. Little need be said here about this uncommon form of obstruction. The clinical signs are equivocal and vary very greatly in severity, according to the tightness of the twist upon the mesentery, and the consequent impairment of nutrition of the bowel which is involved. What has been said already regarding intestine, the vascularity of which is interfered with, applies also to the bowel concerned in a volvulus. In some cases immediate resection is the only course open, but if this has to be done, enterostomy should be performed, the anastomosis being left until later. But so large, as a rule, is the portion of bowel which must be resected, that these cases are attended by a high rate of mortality. It is, therefore, wise to observe what changes occur in the vascularity of the imperilled intestine after the volvulus has been untwisted. It may happen that the appearance alters very considerably, so that a portion of intestine which appeared at first quite hopeless may assume an appearance of viability. If there are any necrotic or doubtful patches, they should be sequestrated individually with Lembert's sutures.

In a case where the patient was so ill that resection would almost certainly prove fatal, this method might afford some prospect of recovery. If only a limited area of the intestinal wall were gangrenous, it would be best, after releasing the twist, to bring that portion out of the wound, and tie a Paul's tube into the bowel at the necrotic spot. By this means drainage is obtained, and at the same time the gut would be so anchored as to prevent a recurrence of the volvulus. The artificial anus so obtained would probably close spontaneously.

(3) Gastric and Intestinal Perforations

Any ulcer of the stomach or intestine may produce peritonitis by perforation, but the more chronic the disease the less likely is it to give rise to a generalised peritoneal infection, because as the ulcer gradually deepens, it tends to become adherent to neighbouring structures. By this means either the base of the ulcer is so strengthened that perforation is avoided, or if perforation does occur, a localised abscess results.

But another factor often comes into play,

namely, traumatism. A sudden strain or distension may at any time rupture the adhesions and so cause leakage into the general peritoneal cavity. There are, therefore, two main causes of perforation :—

(i) An active and rapid necrotic process assisted by distension, such as happens in the case of the appendix, or of a typhoid ulcer ; and (ii) a tearing through of adhesions at the base of a chronic ulcer, or a rupture of the thinned-out floor of an ulcer.

And as the rapidity of the ulceration is dependent upon the activity of the organisms at work, so the peritonitis which results from a perforation of the first class is more serious than that which belongs to the second class. In fact the danger of perforative peritonitis has a direct relationship to the nature and virulence of the organisms concerned in the ulcerative progress. In the case of a gastric or duodenal perforation it is rare to find the colon bacillus in the peritoneal exudate, whilst that organism, in a state of exalted virulence, is by far the most frequent one concerned in perforation of the vermiform appendix.

These facts are of importance in their bearing upon the treatment to be adopted in the various cases.

(a) *Perforated gastric and duodenal ulcer.*

Under this heading may also be included perforated peptic ulcer of the jejunum, which occasionally occurs as a sequel of gastro-enterostomy, of which accident several cases have now been recorded. It is convenient to group these cases together, because the clinical and bacteriological conditions, whilst differing in detail, are in their main features similar. With regard to the bacteriology, the chief point is the rarity with which the colon bacillus is found in the exudate, at any rate in the early stages. The resulting peritonitis is, therefore, of a mild type.

A typical case is diagnosed with ease. There is often a history of indigestion extending over months or years. Frequently those symptoms have been more acute for a few days previously. Then perhaps after an injudicious meal or some unwonted exertion, the patient is suddenly seized with intense abdominal pain and collapse. Vomiting is not as

a rule a prominent symptom and may be absent altogether.

On examination, the abdomen is rigid and motionless, especially in the upper part. When several hours have elapsed it may be found that one or both flanks present the phenomenon of shifting dullness, and that there is decrease or even abolition of the normal area of liver dullness.

Operation. When the diagnosis can be made with reasonable certainty, the abdomen should be opened through the right rectus muscle above the umbilicus. If there is any doubt, the incision should be made below the umbilicus on the right side, because this gives easy access to the appendix and pelvic organs; and should the case prove to be one of gastric or duodenal ulcer after all, it is useful for the purpose of cleansing the peritoneum. In that case it will be necessary to make a second incision at a higher level in order to deal with the perforation.

The greater number of perforations concern the anterior surface of the stomach near the pyloric end of the lesser curvature, or the anterior

aspect of the first part of the duodenum. In about one-seventh of the cases it is the posterior aspect of the stomach which is involved. When this is the case, the exudation will be found in the lesser sac, and in order to gain access to the perforation it is necessary to turn the omentum and transverse colon upwards, and to tear through the transverse mesocolon.

When the perforation has been found it should be closed in the following manner. Two or three sutures of strong silk are passed, so as to include the greater part of the thickness of the stomach wall, and in such a manner as to invaginate the whole ulcer towards the interior of the stomach. A second row of Lembert's sutures is then made to cover in the first. Some surgeons have advocated the performance of a gastro-enterostomy as a routine measure in these cases. The objections to this procedure are (1) that it adds an unnecessary risk by prolonging the operation, and (2) that in the small number of cases in which such an anastomosis is necessary, it can be accomplished with less risk at a second operation.

Having closed the perforation it only remains to deal with the peritoneum. As stated above, the infection is almost always of a mild type, and therefore the interference with peritoneal phagocytosis, which is occasioned by lavage of the peritoneum, is of little account compared with the desirability of ridding the abdominal cavity of the acrid stomach contents. If, therefore, the quantity that has escaped from the stomach is considerable, it is best to wash it thoroughly away with large quantities of saline solution, for which purpose a second incision lower down is of the greatest service. If, however, as often happens, very little has escaped, it is sufficient to cleanse the peritoneum by gentle mopping with dry swabs. The wound or wounds should be closed without drainage.

(b) *Perforated typhoid ulcer*

Cases of successful operation for this otherwise certainly fatal complication of typhoid fever are constantly being recorded, and there are certainly very few cases in which the chance of recovery

which surgery offers should not be given. The result of the operation depends so largely upon its being performed as soon as possible, that the early diagnosis of perforation becomes a matter of urgent necessity. At the very outset the symptoms may closely resemble those of haemorrhage, namely sudden collapse with an abrupt fall of the temperature to below normal, and an acceleration of the pulse-rate. But in perforation other signs rapidly manifest themselves. Vomiting usually occurs early, the abdomen becomes more distended tender, and rigid; and there may be shifting dullness in the flanks together with diminution of the normal area of liver dullness. When a diagnosis of perforation has been made, and the patient's condition is not hopeless, operation should be undertaken without delay. Here rapidity of operation, and the avoidance of unnecessary exposure and manipulation are factors of the greatest importance.

Operation. The incision should be made through the right rectus muscle below the umbilicus. If the perforation is not immediately evident, the

termination of the ileum should be sought for, and the intestine followed upwards. As a rule the perforation will be found within a few feet of the ileocaecal valve. It should be closed by a double row of sutures passed in such a manner that the resulting line of junction lies transversely to the long axis of the bowel. It should be remembered that in several recorded cases a second perforation has been found, and therefore it is worth while also examining the bowel for several feet above the one sutured. Any ulcers, the base of which appear to be extremely thin, should be sequestrated with a few silk sutures. The peritoneum should then be cleansed as far as possible with dry swabs, and the abdomen closed. On no account should extensive lavage be employed, because, in addition to the reasons detailed in the section dealing with appendicitis, the patient is not in a condition to stand any extensive manipulation.

(c) *Perforation dependent upon intestinal obstruction*

There is little to be said on this point. It is a late complication, and often merely the terminal

event, in a neglected case of obstruction, and what has been said regarding the treatment of gangrenous bowel under that heading applies to the cases in this category. The peritoneal cavity may be found flooded with intestinal contents, and in this case lavage of the lower part may be tried with advantage. But every effort should be made to avoid interference with the upper part of the peritoneal cavity which may have escaped contamination from the liability of the fluid to collect in the flanks and pelvis. If the upper part is already affected, or if infection is carried there by injudicious lavage, the case is hopeless.

(4) Appendicitis

The importance of early operation for this disease is so generally recognised at the present day that it is unnecessary to reiterate the arguments in its favour. Fortunately for the patients, the subject is rapidly passing beyond the stage of controversy, and those who regard an acute infective process within the abdomen as a disease to be treated with drugs and fomentations are happily becoming

fewer and fewer. In view of the fact that the mortality of cases operated upon within the first twenty-four hours of the acute attack is no higher than that of the 'interval operation', there are few at the present day who, if the patient's consent could be obtained, would not prefer to cut short the attack, and avoid its possible complications, by immediate operation. Many cases, however, are not seen, or are not diagnosed, until this 'ideal' period has passed, and therefore the various stages at which the disease may first come under observation must still be considered. It must, however, be clearly understood that there is no abrupt line of cleavage between these classes, and that any degree of localisation of the peritonitis may be met with.

The course of any case depends upon the degree of resistance possessed by the individual against the particular strain or strains of colon bacillus concerned. The colon bacillus in one or other of its varieties is now known to be, in the vast majority of cases, the organism chiefly concerned in the peritonitis which results from appendicitis, and

there is good ground for believing it to be the cause of the appendicitis also. This resistance depends, in chief measure at any rate, upon intra-peritoneal phagocytosis, a fact which has considerable bearing upon the line of treatment to be pursued. For the present purpose it is convenient to consider such cases as come within the scope of emergency surgery under two headings :—

(i) Diffuse Peritonitis.

(ii) Local Abscess.

(i) *Diffuse Peritonitis*

By this is meant a spreading peritonitis unlimited by adhesions. It may, at the time of operation, involve only a small area of peritoneum, or it may be spread far and wide over its surface : it may be found to have started from an inflamed but as yet unperforated appendix, or from a gangrenous or a perforated appendix which is in no manner shut off from the general peritoneal cavity. Or it may be found to have originated from an imperfectly shut off abscess, or from a leaking or ruptured abscess. Any attempt at localisation indicates

a certain degree of resistance to the infection, and consequently the prognosis in a case of the latter class is, other things being equal, considerably more favourable than in one of the former class. It must be remembered, however, that neither the degree nor the extent of the peritonitis can be accurately ascertained by any other means than a bacteriological examination of the peritoneal surface at various points.

Operation. The best method of opening the abdomen in these cases is by splitting the right rectus muscle in the direction of its fibres. For this purpose an oblique incision is required, as the muscle fibres, below the umbilicus, pursue an oblique course downwards and inwards which is very far from being parallel with the linea alba. This incision gives access to the appendix in whatever position it may be lying, is capable of enlargement to any desired extent should great difficulty be encountered, and is convenient for drainage should that procedure be considered advisable.

Attention is first directed to securing and removing the appendix. This done, the most important

step remaining is the treatment of the peritoneum. There is no doubt whatever that the best chance lies in local dry cleansing. Copious and widespread irrigation is to be avoided for the following reasons :—

(i) The danger of carrying infection into hitherto unaffected regions.

(ii) Destruction of the phagocytes upon the efficient action of which recovery depends.

(iii) The impossibility of washing clean any part of the peritoneal surface.

The best method of procedure is to take long strips of sterile gauze and gently wipe away the exudate in the region chiefly affected, paying particular attention to the pelvis and right flank where fluid tends to accumulate. The turbid, odourless exudate in the more remote districts should be left alone, because this exudate is rich in phagocytes, and is of a protective nature. Having completed this dry cleansing as far as possible, the abdomen should be closed. Any form of drain becomes so rapidly isolated by the agglutination around it of intestinal coils as to be useless. If, however, there has

already been any attempt at localisation, so that anything in the form of an abscess cavity is present, it is well to leave in a drainage tube for one or two days.

After-treatment. When the patient has been returned to bed, and any shock treated by hot bottles, stimulants, and if necessary, a saline infusion, the chief anxiety is to get the bowels to act. As soon as he is able to swallow, a dose of calomel should be given, followed by drachm doses of sulphate of magnesia every two hours. If the bowels have not acted on the following day, a turpentine enema should be given.

It may be mentioned that in some cases very promising results have been obtained by the use of a multivalent anti-colon bacillus serum. 50 cc. of this serum should be injected subcutaneously, followed by two or three similar doses at intervals of twelve hours.

(ii) *Local Abscess*

Two varieties which are important from the operator's point of view may be encountered.

(*a*) Where the abscess is in contact with the abdominal wall in such a position that it can be evacuated without opening the general peritoneal cavity.

(*b*) Where the evacuation of the abscess necessitated traversing the general peritoneal cavity.

In the former case the incision is placed at the most prominent part of the swelling, and the pus reached by separating the abdominal muscles in the direction of their fibres. In the second case the abdomen is first entered as near to the abscess as possible, and this opening is usually made most conveniently through the right rectus muscle. Several long strips of sterile gauze are next inserted in such a manner as to isolate the abscess from the general peritoneal cavity, and to absorb whatever pus would otherwise tend to soil the peritoneum around. The abscess is then opened into with the finger, and the escaping pus rapidly wiped away with sponges. The cavity must next be dried as far as possible with strips of gauze, the appendix sought for and removed, and a drainage tube inserted. The guarding strips of gauze are now

removed, and the wound closed, leaving the drainage tube projecting from it. It must be admitted that this mode of dealing with an abscess is not one which commends itself to all surgeons, and therefore it is desirable to give the grounds upon which it is recommended.

(i) The fact of localisation indicates a considerable degree of resistance on the part of the peritoneum. Beyond the limits of the abscess there is always a certain amount of exudate rich in phagocytes, so that the peritoneum is on the defensive and is prepared to deal with the small amount of pus which may, during the manipulations, soil it in the immediate neighbourhood of the abscess.

(ii) The colon bacillus tends to die out in an abscess, and the virulence of the pus is, in the great majority of cases, very slight.

(iii) The removal of the appendix takes away the source of the infection, obviates subsequent complications, and does away with the necessity of a second operation.

(iv) The evidence of a large number of cases

shows that the mortality after this operation is no greater than after other methods of dealing with such an abscess.

(5) Peritonitis from other causes

Pathological conditions of the female pelvic organs are not infrequently the cause of acute abdominal symptoms. Some, such as accidents to ovarian cysts, may be readily recognised : others are difficult of diagnosis, and may easily be mistaken for acute intestinal lesions. The symptoms of such conditions are, like those of acute abdominal disease of intestinal origin, primarily those of shock, and secondarily those of peritonitis. The most important factor in any case, therefore, is the nature of the micro-organisms concerned in the peritonitis; and it may be said at once that those found in salpingitis and pyosalpinx are, in the great majority of cases, of the mildest type. Indeed, the pus in cases of pyosalpinx is actually sterile in more than half the cases, whilst in the remainder it is rare to find any other organism than the gonococcus.

On the other hand the peritonitis resulting from infection of ovarian cysts, or from puerperal cases, may be of the most virulent type, such as is caused by the colon bacillus or the streptococcus pyogenes. These several conditions, in so far as they bear upon the surgery of acute abdominal disease, will now be considered separately.

(a) *Changes in ovarian cysts*

Suppuration, rupture, haemorrhage, or torsion of the pedicle may all give rise to sudden and urgent symptoms. It is true that in some of the less severe cases the symptoms subside without operation, but such an outcome cannot be relied upon, and delay may entail hopeless involvement of the peritoneum. Operation should, therefore, be proceeded with at once.

Operation. The abdomen is opened through one or other rectus muscle below the umbilicus, and the condition of the cyst ascertained. In cases of twisted pedicle, or of intracystic haemorrhage, it is sufficient to remove the cyst and close the abdomen. The clear or blood-stained fluid which is

almost always present in the peritoneal cavity is at least harmless, and may be protective, and no attempt should be made to remove it. If, on the other hand, the cyst has burst and has flooded the peritoneal cavity, as much of the fluid as possible should be absorbed with sterile gauze before the abdomen is closed.

If the cyst has become infected, and has given rise to a purulent peritoneal exudation, either by rupture or gangrene, the outlook is very serious, because in some cases a streptococcus pyogenes and in others a colon bacillus has been found in the exudate. Here the same principles of treatment apply as in the case of peritonitis resulting from appendicitis, namely removal of the source of infection and dry sponging of the peritoneum. If it is considered advisable to provide drainage, this is perhaps best accomplished *per vaginam*.

(b) *Affections of the Fallopian tubes*

As has already been stated, the micro-organisms concerned in the peritonitis arising from salpingitis are, as a rule, of a mild type, although occasionally,

doubtless, more virulent organisms reach the peritoneum along the Fallopian tubes. The pneumococcus, for example, has been known to reach the peritoneal cavity from a pyometra.

Gonorrhoeal peritonitis is most frequently of a chronic and local character, attended by the formation of adhesions in the pelvis, but it may be acute and diffuse. There are two circumstances in which the surgeon may be called upon to operate on account of urgent symptoms, namely the rupture of a pyosalpinx, and an acute diffuse gonorrhoeal peritonitis.

(b) *Rupture of a pyosalpinx*

The symptoms to which this accident give rise are those of shock, attended by abdominal pain, rigidity, and vomiting. But as there are no virulent toxins to be absorbed, the patient is markedly less ill than in the case of a similar accident to the appendix vermiformis.

Operation. This consists in removal of the pyosalpinx—and, as the condition is so frequently bilateral, it is usually advisable to remove both

tubes—and the cleansing of the pelvic peritoneum, either by dry sponging or local irrigation. There is no necessity to employ drainage.

(c) *Acute diffuse gonorrhoeal peritonitis*

The onset is usually sudden, but not very severe, and the succeeding symptoms are those of a mild form of peritonitis. It is not a common form of peritonitis, and when it occurs is more likely to be mistaken for a case of perforated gastric ulcer than anything else. Undoubtedly such a case may recover without operation, and if the diagnosis could be made with certainty, it might be advisable in some cases to delay active measures. But operation is usually the safer course. It will, moreover, cut short the illness and prevent such complications as might afterwards arise from adhesions or from the presence of a chronically inflamed Fallopian tube.

Operation. When the abdomen is opened it will usually be found that there is a quantity of clear, straw-coloured, somewhat viscid, peritoneal exudate. From the swollen, reddened Fallopian tubes a few

drops of pus can be squeezed. The tubes should be removed and the peritoneal exudate either sponged or washed away, and the abdomen closed. Here, again, drainage should not be employed.

PNEUMOCOCCAL PERITONITIS

As a complication of some other acute pneumococcal infection, peritonitis from this cause has little surgical interest. Cases, however, do occur in which the peritonitis is, if not the primary, at any rate the most prominent feature of a case of pneumococcal infection. Such peritonitis manifests itself either as a localised intraperitoneal abscess, or series of abscesses, insidious in onset and likely to be diagnosed as tuberculous peritonitis. With such cases this work has no concern. It occasionally happens, however, that a pneumococcal peritonitis has a sudden and acute onset, demanding for its relief instant operation. There are no positive distinguishing signs by which such a case can be recognised; it is likely to be diagnosed as one of acute appendicitis; indeed in rare instances a pneumococcal appendicitis may be the primary

lesion. The condition may be suspected if, when the abdomen is opened, there is no gross lesion found to which the peritonitis can be decidedly attributed ; and if the exudate is of a greenish purulent character, without offensive smell. The nature of such a case can only be definitely decided by a bacteriological examination.

Operation. The best chance of recovery appears to rest upon thorough lavage of the peritoneal cavity with sterilised saline solution ; but it must be remembered that children, in whom this particular affection is more common than in adults, bear any intraperitoneal manipulation badly.

CHAPTER VI

INJURIES OF THE ABDOMEN

Abdominal injuries may be divided into *penetrating wounds* and *contusions*. The former include stabs and gunshot wounds; the latter those accidents which are commonly spoken of as 'buffer accidents', in which the body is crushed between two buffers, or run over by a heavy vehicle. But it must also be remembered that severe abdominal injuries may be sustained by such accidents as falls from a height with or without actually striking the abdomen against anything. Thus, a heavy man falling from a height upon the feet may produce a tearing of the mesentery, from the abrupt and violent strain of a loaded intestine dragging upon it. Many other kinds of injury are also capable of producing serious intra-abdominal lesions. Thus the kidney may be lacerated by striking the loin across a bar in falling; the bladder

may be ruptured by merely stumbling against the corner of a table; the upper abdominal viscera may be penetrated by fractured ribs. The extent of the damage is not to be estimated by the severity of the injury. A heavy cart may pass over a child's abdomen without any ill effects, whilst in another case a blow with the fist may cause the most serious intra-abdominal injuries.

In making a diagnosis, therefore, neither the kind of violence nor its estimated degree is to be allowed undue weight. Nor is the presence or absence of superficial injury, such as bruising and abrasions, of any moment. As a general rule it may be said that the more evident the superficial signs of injury, the less likely is there to be a severe intra-abdominal lesion, because the abdominal wall in exercising its natural protective function will interpose itself with rigid muscles between the injuring force and the abdominal contents, and so will itself suffer more severely than when the blow falls suddenly upon an unexpectant abdomen.

Another point to be borne in mind is that serious results may accrue from a slight injury if there be

at the time any pathological condition within the abdomen. Thus a fall from a bicycle in one instance determined the perforation of a gastric ulcer. An enlarged spleen will be ruptured by a slighter injury than a normal one.

The exact diagnosis of the lesion or lesions resulting from an abdominal injury may be quite simple but is often extremely difficult; indeed in many cases it is impossible to be at all certain as to the nature of the injury before the abdomen is opened. The important point to decide is whether operation must be undertaken or not, and this, in the majority of cases, presents little difficulty. If there is any doubt whatever as to the advisability of operation, preference should always be given to the active rather than the procrastinating policy because an exploratory operation carries with it the minimum amount of risk, whilst a delay of even an hour or two may determine a fatal issue.

The effects of an abdominal injury may be considered under two chief headings :—

(i) Intraperitoneal haemorrhage.

(ii) Damage to a hollow organ.

(i) *Haemorrhage.* The symptoms depend upon the amount of blood effused and the rapidity with which the effusion takes place. It may be so rapid as to cause death without the possibility of surgical interference, or it may be so slight that the blood may be absorbed from the peritoneal cavity without any ill effect resulting. Between these two extremes lies every conceivable degree. In some instances the blood escapes so slowly that a localised haematocele results, which may give rise later to an intra-abdominal abscess : in other cases the haemorrhage is neither large enough of itself to cause death, nor small enough to become absorbed, nor slow enough to become encysted : such cases are apt in the course of two or three days to develop a diffuse peritonitis from which the patient will die if unrelieved. The risks of diffuse peritonitis and of intra-abdominal abscess render it imperative to operate without delay upon every case of intraperitoneal haemorrhage which is of sufficient severity to be capable of diagnosis.

(ii) *Damage to a hollow organ.* If it is advisable to operate upon every diagnosable case of haemor-

rhage, still more necessary is it to operate upon every case in which damage to a hollow organ is diagnosed or even suspected. It is true that some slight cases of bruising of bowel or even of actual perforation may recover spontaneously. Adhesions, especially of the omentum, may act as well as the stitches of the surgeon, but such events are to be regarded as curiosities and are not to be reckoned upon. Micro-organisms, particularly the colon bacillus, can make their way through the wall of a bruised but unperforated intestine, and the result of an untreated intestinal injury is usually a fatal peritonitis.

METHOD OF EXAMINATION

The patient must be laid upon the back in bed, in a good light, with the abdomen fully exposed. Inspection will then determine the presence or absence of superficial injuries, and the degree of *mobility on respiration.* Sometimes one region of the abdominal wall will be observed to move better than another, a point which may be of great assistance in the localisation of the lesion.

Palpation will reveal the presence or absence of *rigidity* of the abdominal wall as a whole or a greater degree of rigidity in one place than another. This may be of considerable assistance in localising the site of the internal injury. Both lack of mobility and rigidity, however, may be occasioned by fractures of the ribs or pelvis alone, without internal injury, and careful examination of those structures should therefore always be made.

Percussion is of great value, provided that its fallacies are constantly borne in mind. *Shifting dullness* in the flanks may indicate the presence of a large effusion of blood, gastro-intestinal contents, or urine; but a bunch of collapsed intestinal coils, such as frequently results from an abdominal contusion, may equally produce the physical sign of shifting dullness. On the other hand the presence of quite a large amount of fluid in the abdomen is by no means incompatible with the absence of dullness in the flanks.

The presence or absence of *liver dullness* may be an equally fallacious sign; it requires quite a large amount of free gas in the peritoneal cavity to pro-

duce any certain degree of obliteration of the normal liver dullness, especially if the perforated organ is situated low down in the abdomen and under shelter of the great omentum. On the other hand, a distended colon pushed upwards may give rise to a tympanitic percussion note over the costal right margin anteriorly.

The *general condition* of the patient must be carefully estimated. There may be a profound degree of *shock* in a case where the opening of the abdomen would reveal nothing abnormal, whilst it sometimes happens that quite an extensive laceration of the bowel is accompanied by very little shock.

Vomiting, again, may be present in slight, and absent in severe injuries, or vice versa.

In fact it may be said that no one of these symptoms and signs taken alone is of much value in making a diagnosis; they must all be pieced together, and the clinical picture presented must be looked at as a whole.

The most important and reliable sign, and one which may, on account of its significance, be regarded as standing alone is the

pulse-rate. It is not infallible, but it is by far the most reliable guide. This should be taken and recorded at regular, short intervals. At first rapid, it frequently slows down somewhat when the first shock is passing off; any subsequent acceleration should be regarded as exceedingly serious, and is sometimes sufficient of itself to warrant an exploratory operation. A steadily increasing pulse-rate indicates either progressive haemorrhage or spreading peritonitis from the rupture of a hollow organ.

The following is a good illustrative case. A boy, eighteen years of age, had been shot in the abdomen, close to the umbilicus, with a revolver bullet. He was brought to hospital at once, and presented absolutely no symptom or physical sign of intra-abdominal injury, except that the pulse-rate steadily increased from 90 to 120. The abdomen was opened twenty hours after the injury, operation being determined upon by this one symptom, and there were found two perforations and three bruises in the ileum. These were sutured and he made an uninterrupted recovery.

The *examination of the urine* should not be neglected. The presence of blood will point to an injury of the bladder or kidney, but its absence does not exclude the possibility of such an injury, as the kidney may be extensively damaged and the blood prevented from reaching the bladder either by rupture or blocking of the ureter by clot. Haematuria, however, does not of itself provide sufficient ground for operating, as many cases of renal contusion or of slight retroperitoneal laceration get well without operation.

INDICATIONS FOR OPERATION

1. If symptoms of shock persist, the abdomen remains rigid, the pulse increases in rapidity, the lips become blanched, and dullness is noted in the flanks, the case is probably one of intraperitoneal haemorrhage, and operation must be undertaken as soon as possible.

2. If the abdomen becomes more rigid, vomiting persists, loss of liver dullness is noted, and above all, if the pulse progressively increases, the case is

probably one of ruptured stomach or intestine, and operation must be performed immediately.

3. If the pain and rigidity are more marked in the lower part of the abdomen, frequent futile attempts at micturition are made, and the catheter withdraws only a small amount of bloody urine, and especially if a fracture of the pelvis is present, operation for probable rupture of the bladder should be undertaken at once. A word of warning is not out of place here. The fact that a large quantity of urine can be readily withdrawn is not conclusive proof of the integrity of the bladder, because the instrument may pass through a rent in the vesical wall, and withdraw urine, which may or may not be mixed with blood, from the peritoneal cavity.

Having decided to operate, the question may arise whether or not to wait until shock has passed off. It may be said at once that unless the patient is *in extremis*, in which case operation is unlikely to hold out any prospect of recovery at all, the presence of shock should in no way delay the operation. It is quite a common experience to

find that the administration of an anaesthetic causes the general condition to improve considerably. If the symptoms are very severe it is wise to perform intravenous saline infusion as soon as the anaesthetic has commenced.

Operation. Even if a definite diagnosis has not been arrived at, there will probably be some indication as to the region in which the lesion lies, as has been pointed out previously, in which case the incision should be made through the rectus sheath, splitting the muscle in the direction of its fibres, as near to the site of the supposed injury as is practicable. If there is no such guide, then the incision should be made to one side or the other of the umbilicus : it can readily be extended upwards or downwards when the lesion is discovered. Much, as a rule, depends upon completing the operation as rapidly as possible, for which purpose it must be remembered that a small and timid opening increases the difficulty of exploration, hampers manipulation, and wastes valuable time. On opening the abdomen it will at once be evident whether there is diffuse intraperitoneal haemor-

rhage or not. If free blood is found, the source of the bleeding must be sought for and dealt with. It is rarely worth while attempting to suture rents in the liver or spleen. If such are found they should be tightly plugged with long, broad strips of sterile gauze. The question of removal of the *spleen* is one upon which different opinions are held. Obviously there are some cases of total disorganization in which the only possible plan is to perform splenectomy, but there are other cases in which the organ, although extensively torn, may be saved by the plan of packing the rent with gauze and leaving one end out of the wound to be gradually removed after a few days. That a patient can survive without a spleen has been amply proved, but that furnishes no justification for the removal of an organ which might possibly be saved.

In the case of *the liver*, there is no course open but to plug the rent with long strips of gauze, the ends of which are left projecting from the abdominal wound. If the patient survives, these plugs will gradually become loose, and can be removed by withdrawing a little at each dressing.

If the rupture involves the *kidney*, the surgeon will have to decide whether or not to remove it. As in the case of the spleen, an organ which can by any possibility be saved should not be removed. The kidney, being of a fairly firm consistence, and having a tough, fibrous investment, can be sutured, and wounds of this organ heal well. If, therefore, the main renal vessels are not torn, an attempt, by suturing and plugging, should be made to save the organ, any subsequent leakage of urine being provided for by a drainage tube introduced through a small incision in the loin.

The bleeding is sometimes found to proceed from *torn mesentery* or *omentum*, in which case it must be dealt with by ordinary means.

When the bleeding, from whatever source, has been arrested, the peritoneal cavity should be washed free of blood and clot with a copious stream of normal saline solution at a temperature of 105° F. This may be done by means of a tube connected with an irrigator, but if the apparatus is not at hand, the fluid may be poured directly into the abdomen from a large jug.

If there is any reason to suspect a rupture of one of the *hollow viscera,* these must be examined systematically, beginning with the stomach, and following down the intestine coil by coil. An examination of the gall bladder should not be neglected. A rupture of the urinary bladder will usually manifest itself by the presence of clear fluid in the peritoneal cavity. Should a laceration or perforation be found, it must be sutured in two layers, the first including the whole thickness of the bowel wall, and the second burying the first by a continuous Lembert's suture.

In a few instances the bowel is torn completely across, in which case it may be advisable to employ a Murphy's button, if that is ready at hand, in order to save time. After suturing the rent, the peritoneal cavity should be washed out with normal saline solution, and the abdomen closed.

Such is the diversity of the lesions which may be present as the result of an abdominal injury, that it is impossible to do more than indicate the general line of treatment to be adopted. The operator must be prepared to deal on general

surgical principles with any damage which may be discovered.

After-treatment. It is frequently necessary to introduce fluid into the circulation after the patient has been put back to bed, and this may be done either by intravenous infusion, or rectal injection. Stimulants also may be required. Morphia should be given sparingly or, if possible, avoided altogether on account of its liability to cause intestinal paralysis, and its inhibitory action upon the phagocytosis which is of such vital importance in the restoration of the peritoneum to its normal condition. It is of great importance to secure early and free action of the bowels, for which purpose a dose of calomel should be given as soon after the operation as possible, and this should be followed by drachm-doses of magnesium sulphate given four-hourly until the bowels act. The intestinal distension which so often occurs after such operations can be relieved by turpentine enemata. Small quantities of fluid nourishment may be given by the mouth as soon as sickness has ceased.

INJURIES OF THE BLADDER

These injuries, presenting as they do certain peculiar features, must be considered separately from other abdominal injuries, although the causes and general symptoms are in many instances the same. Fracture of the pelvis, whilst adding considerably to the gravity of the case, in no way alters the treatment to be adopted.

A great deal has been written about the differences between intraperitoneal and extraperitoneal rupture of the bladder, but in healthy persons the distinction is of little practical value, especially as the rent is not infrequently found to implicate both peritoneal and non-peritoneal aspects. Provided that the urine is healthy, and operation is promptly carried out, the risk of peritonitis is slight. But in those rare cases in which the bladder wall, already weakened by disease, gives way from slight violence, the outlook is extremely grave. It is in such cases as these, with septic urine, that the prognosis with an intraperitoneal is worse than with an extraperitoneal rupture.

The symptoms of rupture of the bladder are as a rule sufficiently clear for a definite diagnosis to be arrived at: shock is usually present, and a fracture of the pelvis will increase the likelihood of there being a rupture of the bladder or a laceration of the urethra. The patient desires to pass water frequently but is unable to do so: he may from time to time void a little bloody urine. There may be shifting dullness in the flanks. On passing a catheter, nothing may be withdrawn except perhaps a little bloody urine. On the other hand, the result may appear to be normal, for the catheter may pass through the rent and tap the urine that had escaped into the peritoneal cavity. The injection of fluid into the bladder as a means of diagnosis is a useless procedure and not devoid of danger. If there is any doubt at all whether the bladder is ruptured or not, exploration should at once be proceeded with.

Operation. A median incision, immediately above the pubic symphysis, passes between the two recti muscles and exposes the subperitoneal tissue. The lower peritoneal reflection is then sought for

and retracted upwards. The bladder is opened and explored with the finger. If the rent is found to involve only the peritoneal aspect of the bladder, the incision is continued upwards in order to open the peritoneal cavity. The rent is then closed with two rows of continuous suture, the first, of catgut, includes all the coats; the second, of fine silk, involves peritoneum only. The peritoneal cavity is next flushed out with sterile saline solution, and closed. A drainage tube is left in the bladder for a few days.

Should the rent be found to be entirely extra-peritoneal, it should be sutured with catgut, and the bladder drained as before. In this case the peritoneum will not be opened. Sometimes the tear involves both peritoneal and non-peritoneal aspects. In this case the operation must be as for intraperitoneal rupture.

PELVIC AND PERINEAL INJURIES

Rupture of the urethra

This accident may occur alone, as from falls and kicks upon the perineum; or in association with

fracture of the pelvis. Any degree of laceration may be present, from a slight tear to complete disruption with wide separation of the ends. Great difficulty may be experienced, in what appear to be the slighter cases, in determining whether operation should at once be proceeded with or not, but it may be laid down that, as a general rule, there is a great deal more risk in temporising than in operating.

The symptoms of ruptured urethra are intense pain, accompanied by frequent fruitless efforts to micturate. There may be the escape of a few drops of blood from the meatus, and occasionally the haemorrhage is so brisk as to be actually alarming. Frequently there are some local signs, such as tenderness, ecchymosis, or definite urinary extravasation in the perineum. On introducing a catheter, it may be found that the instrument is arrested and cannot with gentle manipulation be made to pass the site of injury. In this case operation must at once be proceeded with.

If, however, the catheter does pass easily into the bladder and there is no extravasation, it may

be left there, in the hope that the urethra will heal over it without further trouble. But if this expectant plan is adopted, a very close watch must be kept for signs of extravasation. The objection to this method is that the laceration may be severe though incomplete, and that the catheter may have slipped in by good luck. In such a case, the amount of cicatricial tissue will be considerable, and the resulting structure may prove intractable.

Operation. The patient is placed in the ' lithotomy position ', with the pubes, scrotum and perineum shaved and cleansed. The site of the laceration having been determined by a sound in the urethra, an incision is made over it in the mid-line, and is deepened until the urethra is reached. The presence of blood clot infiltrating the tissues will probably cause some difficulty at first, but as it is removed it may be found to be of actual assistance by having, as it were, dissected out the urethra in the region of the laceration. The urethra must now be sutured, and the best material for the purpose is catgut. It will rarely be found that the urethral

roof is torn, but if this should be the case, the first stitches must be passed from inside the urethra, and made to close the rent in its roof.

A large gum-elastic catheter should next be passed from the meatus into the bladder, and the suturing of the urethra completed over it, first on the lateral, and finally on the inferior aspects. No sutures are to be placed in the perineal wound, which should be packed with gauze. If extravasation has already occurred, free incisions into the infiltrated tissues will be required in addition.

After-treatment. The catheter remains *in situ* for ten days unless any untoward symptoms should demand its removal earlier. It is well to let the patient lie in a bath for half an hour daily until the wound is healed. Subsequently a large-sized sound should be passed at regular intervals in order to prevent the formation of a stricture.

CHAPTER VII

STRANGULATED HERNIA

The strangulation of a hernia usually occurs during some act of straining, and is attended by sudden local pain, together with a feeling of faintness, and sickness. On examination the hernia is found to be larger and more tense than usual, tender, and devoid of impulse on coughing. A word of warning may be given with regard to impulse on coughing, because too much importance is apt to be attached to this most fallacious sign. It requires great delicacy of touch to be able to distinguish between the impulse in the hernia itself, and the sensation communicated to it as a whole by the sudden upheaval of the abdominal wall, especially in a fat patient. The following case illustrates another circumstance in which the sign proved fallacious. A patient with a tender,

somewhat tense, serotal hernia was admitted with symptoms of intestinal obstruction, but as there was a good impulse in the hernia, operation was delayed for some hours. The symptoms, however, persisting, the sac was opened, when a coil of small intestine was found ensnared and obstructed beneath a band which traversed the hernial sac. The delay proved fatal.

The subsequent symptoms are those of intestinal obstruction. It should be remembered that a stool may be passed subsequently to the onset of the symptoms, owing to the evacuation of the bowel contents already there : and also that flatus or even loose stools may be passed if the strangulation concerns omentum only, the vermiform appendix, a Meckel's diverticulum, or only a portion of the intestinal wall (Richter's hernia).

Several other conditions which may simulate strangulated hernia should be borne in mind. An inflamed inguinal gland, a labial abscess, the torsion of an imperfectly descended testis, or an inflamed hydrocele may all be mistaken for strangulated hernia. It must be remembered too, that a small

femoral hernia in a fat patient may escape notice unless a very careful examination is made. If there is any doubt at all about the diagnosis, it is far better to operate at once than to run the risk of neglecting a strangulated hernia.

Treatment. The question is often asked whether it is or is not legitimate to employ taxis before proceeding to operation. A good deal must depend upon the circumstances of the individual case. In infants, gentle taxis will frequently prove successful, and old-standing inguinal herniae, previously reducible, will also often prove amenable, especially under an anaesthetic. But in a tightly nipped, recent hernia, especially of the congenital variety, it is almost certain that taxis will not only be unsuccessful but will also do harm. Again, strangulated femoral herniae can far less often be reduced than inguinal, whilst umbilical herniae rarely yield to this form of treatment.

The manipulation of a piece of strangulated gut, during attempts to reduce it, may cause so much damage as to determine the onset of gangrene. This risk must not be lightly undertaken, and it

may, therefore, be laid down as a general rule that taxis is to be reserved for those cases in which either the means of operation are not at hand, or the patient is, on account of age, disease, or other circumstances, unsuitable for an operation of any kind.

Taxis, therefore, should be applied with discrimination, and always with extreme gentleness, and in the right direction. In an inguinal hernia the thigh should be slightly flexed, the neck of the hernia should be grasped between the finger and thumb of the left hand, and traction exerted upon it: the right hand should grasp the hernia and, after a few moments' gentle pressure, should push the rupture upwards and outwards. Similar manipulations are to be employed for femoral herniae, but the direction must be inwards and backwards.

Operation. In inguinal hernia an oblique incision is made over the neck of the sac in the direction of the inguinal canal; in femoral hernia the best method is that of raising a small flap with the convexity inwards, so as to expose the femoral ring before the sac is opened. In umbilical herniae

a crescentic incision should be made to one side or other of the tumour, and the umbilical ring identified. The skin and sac over the front of an umbilical hernia are usually so closely adherent that an incision in this situation would at once open the sac. But nearer to the abdominal wall some connective tissue intervenes so that the two structures can be identified and separated from one another.

In either variety, after opening the sac the constriction must be divided; at the most convenient spot for umbilical hernia, in an upward direction for inguinal hernia, and directly inwards for femoral hernia. It is best to make several small nicks in the constricting ring in preference to one deep one.

The hernial contents should now be pulled down so that a thorough view may be obtained of the site of constriction. If omentum is involved, this may be at once tied off and cut away, several small portions being ligatured separately rather than one thick bunch. A convenient pedicle may be obtained by crushing the omentum in an appendix-clamp. Fairly thick silk should be used as this

does not tend to cut through the omentum as do the finer sizes.

The *condition of the bowel* should be carefully inspected after the constriction has been relieved. More will be learnt by waiting a few moments than is possible directly the sac is opened, as considerable improvement in appearance may take place with the restoration of the circulation. Unfortunately it is impossible to lay down any definite rules for the guidance of the surgeon in forming an opinion either as to the state of the bowel or the treatment to be adopted : even experience, the safest guide, will sometimes be found at fault. The *colour* of the bowel is perhaps the least reliable test, as a coil which is almost coal black will sometimes recover, when an only slightly congested one will become gangrenous. The degree of *smoothness* of the peritoneum and the presence or absence of fibrin upon its surface are useful as indications, but are not to be greatly relied upon. The degree of *elasticity* is more important, as a piece of bowel which has lost its natural resilience and become soft and inelastic to the touch has little chance of recovery.

A *mottled* appearance of the gut, especially if any of the patches have a greyish look, and well-marked *constriction rings*, that is to say, a thinning of the bowel wall at the actual site of strangulation, are both signs of great importance. They signify deep ulceration of the inner coats, and are points at which perforation would probably occur if the bowel were to be returned within the abdomen. Not only are such constriction rings possible sites of perforation, but they render the intestine peculiarly liable to become kinked at that spot, a condition which may cause fatal obstruction. They may also cause stenosis from cicatricial construction, and obstruction at a later date.

TREATMENT OF THE INTESTINE IN A STRANGULATED HERNIA

This may conveniently be discussed under the following headings :—

(i) When the bowel is certainly viable.

(ii) When the viability is in doubt.

(iii) When actual gangrene is present or is inevitable.

(i) In this case the gut should be washed over with sterile saline solution and returned into the abdomen, and if, as is probably the case, the patient is in good condition, a radical cure should be effected at the same time.

(ii) The gut should be washed over and replaeed, a gauze drain being inserted through the hernial orifice down to the doubtful coil. If necessary, a radical cure can be performed later. The coil of bowel does not tend to move away from its situation ncar the hernial orifice, and if perforation should occur, the coil will have been by that time isolated from the general peritoneal cavity by adhesions, so that the intestinal contents will escape along the track of thc gauze drain. The faecal fistula which results will probably close spontaneously, but if not, it ean be dealt with by a subsequent operation.

(iii) In a certain number of cases, particularly in young children in whom resection is almost certain to prove fatal, it is sufficient to scquestrate any isolated gangrenous patches, and then treat exactly as one would do a doubtful piece of bowel.

If the constriction rings are particularly well marked, and the loop itself is apparently viable, it may in the same manner be sufficient to sequestrate them by a circular, running suture.

When, however, the whole loop is gangrenous, then four courses are open :—

(*a*) To resect, perform anastomosis, and complete the operation by a radical cure.

The cases to which this line of treatment is applicable are obviously few. By the time that gangrene has occurred, the patient is probably too ill to stand a prolonged operation. A suitable case would be that afforded by a patient—young, otherwise healthy, and in good general condition—in whom the strangulation had been present only a short time. The herniae which most rapidly become gangrenous are the congenital ones which appear suddenly and become strangulated at once, because in these cases the constriction is usually extremely tight.

(*b*) To resect, perform anastomosis, and leave a drain down to the anastomosis, performing a radical cure at a later stage.

(*c*) To resect and establish a faecal fistula by tying a Paul's tube into each end of the divided intestine. There is a grave objection to this method of procedure. It is impossible to tell what part of the small intestine is involved, and, if it happens to be high up, the patient will rapidly suffer from malnutrition, while the skin will become digested and render further operation both difficult and dangerous.

(*d*) To pack gauze around the gangrenous coil so as to shut it off from the abdominal cavity, and then to cut away the greater part of it, so as to establish a faecal fistula which may be dealt with at a later stage. This is an elementary procedure which is applicable only to very bad cases. Such an operation is best performed under local anaesthesia.

RESECTION OF GANGRENOUS INTESTINE

In view of the patient's general condition, the most rapid method of resection and anastomosis is the one to be adopted. Obviously an end to end junction takes less time than a lateral anastomosis

which also necessitates closure of the two cut ends ; but opinions differ as to the best means of effecting the end to end approximation. Two methods will be briefly described.

The Resection. Although the whole intestine above the obstruction will be distended and filled with faecal fluid rich in virulent micro-organisms—and it would be difficult to find any spot at which the gut could be said to be healthy—yet it is a fact that the further away from the gangrenous coil the section is made, the more likely is the result to be satisfactory. On the other hand, the greater the amount removed, the greater will be the shock. Perhaps it may be laid down, therefore, that not less than eighteen inches of bowel above the obstruction should be removed. At the distal end it is not necessary to make the section quite so far below the obstruction. The site of section having been decided upon, an intestinal clamp is to be applied a few inches beyond the spot, and the bowel cut across with scissors. If the area of operation has been well packed off with gauze, the risk of soiling with intestinal contents is greatly lessened. The

mesentery is next tied off in sections with fairly stout silk, and cut through bit by bit.

The Anastomosis.—(i) The simplest method is that of suturing without mechanical appliances. It is to be performed as follows. The first stitch is a single one, and is to be passed through the mesentery of both ends, close to the bowel wall, in such a manner as to shut off that small, triangular area of the intestinal wall which is uncovered by peritoneum. Next a long silk thread, carried on a straight needle, is run round the cut edges, passing through the whole thickness of the bowel wall, and so approximating the edges all the way round. With a little care the difficulty caused by the distended gut being larger than the collapsed can be readily overcome. Care must be taken not to draw the thread tightly enough to produce stenosis. A second continuous suture is then passed round the line of junction, taking up peritoneum only, so as to bury the first line of junction completely.

(ii) The method afforded by Murphy's button is perhaps, in the hands of those accustomed to its use, a little more rapid than that just described.

A continuous suture is run round the mouth of each intestinal segment, close to the edge, and including its whole thickness. Into each end one half of the button is introduced, and whilst it is held in place with a pair of forceps, the purse-string suture is drawn tightly around it and tied. When the two halves of the button are pressed together, the anastomosis is complete.

CHAPTER VIII

RESPIRATORY OBSTRUCTION

The conditions which give rise to dyspnoea, and threaten asphyxia, are many and various. Such cases as belong to the province of the physician and are beyond the reach of surgery will not be discussed here, and only those which are capable of relief by surgical intervention will be considered.

It occasionally happens that a patient when first seen is *in extremis*, in which case it is necessary to perform tracheotomy at once, without coming to a definite diagnosis as to the cause. But in the large majority of cases there is ample time to make a diagnosis and to carry out the appropriate treatment with deliberation, and without the haste which is sometimes bred of panic.

The main lines of action in these cases are sufficiently simple in theory. They are :—

(1) To remove the obstruction, or

(2) If that is impossible, to make an opening into the air-passage below the site of obstruction, or

(3) To introduce some form of tube into the air-passage past the obstruction.

The following forms of respiratory obstruction which are commonly met with, fall into certain main groups, and will be dealt with *seriatim*.

I. FOREIGN BODIES IN THE AIR-PASSAGES

Much will depend upon the size, shape, and consistence of any foreign body which may have found its way into the air-passages. If small, smooth, and rounded such as a pea or fragment of a nut, it may fall through the rima glottidis into the trachea or bronchi. If large, or not of suitable shape to pass between the vocal cords, it may remain lodged in the larynx and produce respiratory obstruction, either by its size and position, or by inducing reflex spasm of the laryngeal muscles, or by causing oedema of the larynx.

(a) *Foreign body lodged in the larynx*

The symptoms of this accident are cough, alteration of voice, and dyspnoea of varying degrees of

urgency. The diagnosis is to be confirmed by means of the laryngoscope, after which steps must immediately be taken to remove the obstruction.

Treatment. The first thing to do is to see that the tracheotomy instruments are at hand. An attempt may then be made to dislodge the foreign body by lowering the head and inducing a cough, a proceeding which sometimes proves successful. If this fails, the laryngeal forceps must be tried, aided by the laryngeal mirror. In children it is necessary to administer chloroform for this purpose, and it must be remembered that both the administration of an anæsthetic and the manipulations of laryngoscopy are liable to induce an attack of urgent dyspnœa. It is for this reason that the surgeon must be prepared, before beginning any such manipulation, for the immediate performance of trachcotomy.

Sometimes a foreign body such as a tooth-plate cannot be removed with forceps because of its impaction in the larynx, and if there is a hook upon the plate, extraction through the mouth may be effectually prevented. In such a case recourse

must be had to the *operation of thyrotomy*. Tracheotomy must first be performed. A vertical incision is then made in the mid-line over the larynx, the fasciae divided, and all haemorrhage arrested. The alae of the thyroid cartilage are then to be separated by a vertical incision exactly in the mid-line, and held apart as widely as possible with sharp hooks, when the foreign body can be removed with forceps. The cartilages are next to be accurately approximated with sutures, and the wound closed. The tracheotomy tube is to be left in for a few days, during which time the patient is kept in bed protected by a tent in which the air is kept moist by means of a steam-kettle.

(b) *Foreign body lodged in the trachea or bronchi*

As such a body has passed through the rima glottidis, it is only reasonable to suppose that it can be ejected by the same route. But it must not be forgotten that attempts to bring this about may be followed by dangerous laryngeal spasm, and such attempts should not be made unless the surgeon is prepared to perform instant tracheotomy.

The head should be lowered and the chest raised : the foreign body unless impacted may thus be made to roll towards the larynx, when it may be expelled by a fit of coughing. If it is necessary to give chloroform for this purpose, the degree of anaesthesia should be very light. Failing expulsion by this means, the trachea must be opened, and an attempt made to grasp the object with forceps. If the low operation is performed, and the patient is a child, it is surprising with what ease the forceps can be passed into either bronchus. Even if the forceps cannot grasp the foreign body it may happen that the irritation of their introduction may bring about a fit of coughing, which may dislodge the foreign body and bring it within reach of the forceps or of a scoop. It is a great advantage in this operation to have the chest well raised and the head lowered. A forehead light is essential, and enables the operator to see into the bronchi with great ease.

II. OEDEMA OF THE LARYNX

This condition may arise very rapidly from any of the foregoing causes :—

Scalds and burns of the throat.

The presence of a foreign body.

Cellulitis of the neck.

Acute laryngitis.

Any form of laryngeal ulceration.

Insect stings.

Renal disease.

(a) *Scalds and burns*

A child who has scalded the throat should be put to bed, with a tent and steam-kettle, and carefully watched. Should the dyspnoea become at all urgent, two courses are open, intubation and tracheotomy. In these cases it is always worth while trying the former procedure, as the introduction of an intubation tube for only a few hours may tide the patient over the danger and obviate the necessity of a cutting operation. But the surgeon should be prepared to perform tracheotomy if this means fails.

The easiest way to perform intubation is to have the child held in a sitting position by a nurse, facing a good light, and with the arms enveloped in a towel to prevent struggling. An assistant holds the mouth open with a gag. An intubation tube of suitable size, attached to the guide, is then taken in the right hand, whilst the left index finger feels for the upper aperture of the larynx and guides the tube over the back of the tongue and epiglottis into the larynx. The guide is then withdrawn, and the silks attached to the tube are secured to the cheek with a piece of strapping.

The same procedure may be adopted in the more uncommon cases of oedema arising from insect stings and other causes.

(b) *Tuberculous and syphilitic laryngitis*

For oedema arising in the course of these diseases intubation is not to be recommended, but tracheotomy or laryngotomy should be at once performed. In the tuberculous cases the opening will probably have to be permanent.

(c) *Cellulitis of the neck*

The diffuse brawny infiltration of the neck due to septic infection, and commonly known as 'Ludwig's angina', sometimes gives rise to urgent dyspnoea, which may come on at any moment, and is very apt to be induced by the administration of an anaesthetic for the purpose of making incisions. It is most desirable to avoid, if possible, making an opening into the trachea in such cases, because it is almost certain that septic material will be inhaled, and thereby grave risk of septic pneumonia is incurred. It is, therefore, advisable not to give a general anaesthetic if it can possibly be avoided. When an anaesthetic is necessary chloroform should be preferred, and if urgent dyspnoea comes on during the operation the mouth should be held open with a gag, and a large-sized, gum-elastic catheter should be passed through the larynx into the trachea. This is not at all a difficult procedure if the catheter is guided over the back of the tongue and epiglottis by means of the left forefinger. In this manner the danger of suffocation can be averted without the difficulty

attending a hurried tracheotomy through the tissues of a swollen neck, and without the subsequent risks of septic pneumonia.

The relief of pressure afforded by free incisions into the inflamed cellular tissue of the neck will remove the danger of laryngeal obstruction again occurring from this cause.

III. DIPHTHERIA

This is of course the commonest cause of respiratory obstruction in children. Into the vexed question of the relative value of intubation and tracheotomy it is not proposed to enter here. It is enough to say that the difficulty of intubation, not so much in its actual performance as in persuading the tube to remain in place, and the risk of pushing membrane down in front of the tube, have led the majority of surgeons to abandon its employment as a routine measure in diphtheria. Tracheotomy is the operation which finds favour with the majority, and of the two operations the 'low' is to be preferred to the 'high'. If the opening is made as far below the larynx as possible

there is rarely any difficulty experienced in leaving out the tube subsequently, such as occasionally occurs after the high operation.

IV. RETROPHARYNGEAL ABSCESS

This is not an uncommon cause of dyspnoea in children, and may easily be mistaken for diphtheria by the careless. A digital examination of the pharynx will readily settle the question. The abscess should be incised from the mouth, the child's head being thrown well backwards over the end of the table, so that the pus is made to flow away from the larynx. It is rarely necessary to perform tracheotomy.

V. LARYNGEAL GROWTHS

These may be benign or malignant growths arising within the larynx, or malignant growths invading the larynx from other regions such as the pharynx or thyroid gland.

In children, particularly of the hospital class, papillomata of the larynx may be unsuspected until the patient is suddenly seized with dyspnoea

due to the mechanical obstruction, or to oedema or laryngeal spasm occasioned by them. Such a case will probably require tracheotomy and subsequent removal of the growths. But if the dyspnoea is only gradually becoming worse, and the patient is known to have laryngeal papillomata, an attempt may be made to relieve the symptoms by removal with forceps, or intubation may be tried.

In cases of malignant disease, tracheotomy or laryngotomy should be proceeded with at once, and this opening will have to remain permanently.

VI. DYSPNOEA DUE TO GOITRE, EITHER BEFORE OR AFTER OPERATION

Leaving out of account those cases in which the recurrent laryngeal nerves have been injured, respiratory obstruction from this cause is not laryngeal but tracheal, and is due to the absorption of the tracheal cartilages, so that the trachea does not remain patent in all positions of the neck. In such cases urgent dyspnoea is apt to occur upon exertion, or during sleep.

It may be extremely difficult to find and open the deeply placed or displaced trachea, and in such a case the best plan is to pass a large-sized, gum-elastic catheter through the larynx into the trachea in the manner already described under cellulitis of the neck. An ordinary intubation tube is too short to be of any service. If tracheotomy is performed it will be found that the ordinary tube is too short to get past the obstruction. To overcome this difficulty there is a specially constructed long tube made of flexible wire (König's tube); but if this is not available, a large-sized soft catheter answers the purpose admirably, especially if it is threaded through an ordinary rubber tracheotomy tube of slightly larger calibre so that the catheter projects two or three inches beyond it.

THE OPERATIONS OF LARYNGOTOMY AND TRACHEOTOMY

Laryngotomy is the operation of opening the air-passage immediately below the larynx, that is to say, through the crico-thyroid membrane. In an emergency it can be performed with a pocket

knife and a hairpin, and is sometimes facetiously termed the 'after-dinner' operation.

A small, vertical incision is made between the cricoid and thyroid cartilages in the mid-line, and the crico-thyroid membrane is incised transversely. A laryngotomy tube, which is distinguished from a tracheotomy tube by being flattened instead of cylindrical, is then introduced.

Tracheotomy. This operation involves the opening of the trachea below the cricoid cartilage. It is spoken of as 'high' or 'low', according to whether the tracheal incision is made above or below the isthmus of the thyroid gland.

But this distinction is found in practice, particularly where children are concerned, to be of little practical importance. In point of fact, the thyroid isthmus is not infrequently divided during the operation, a circumstance which is not attended with the dire results sometimes ascribed to it. If this structure is encountered, there is no harm in dividing it vertically in the mid-line.

The head is thrown well back, the shoulders being supported by a firm sandbag. The cricoid

cartilage should then be identified, which can always readily be done if the finger is passed upwards along the mid-line of the neck from the top of the manubrium sterni. The surgeon, standing at the patient's right side, makes an incision from the cricoid cartilage down to the sternum. It should be remembered that nearly all the difficulties and accidents of tracheotomy, particularly in young children, arise from making too small a skin incision. A combination of skill and luck sometimes enables an operator to perform a 'button-hole' tracheotomy, but the ordinary man had far better err on the side of too large than of too small an incision.

The deep fascia is next divided, also in the mid-line, so as to enable the infra-hyoid muscles to be separated, together with the anterior jugular veins. The separation is best accomplished by means of retractors. The thyroid isthmus is now exposed, and may be either drawn upwards or downwards or divided. This exposes the trachea, which should always be seen clearly before it is incised. It is best to tie off all bleeding-points at this stage. The knife is now taken penwise between forefinger

and thumb so as to leave exposed only about a quarter of an inch of blade, and is entered at the lowest point of the proposed incision and carried upwards towards, and if necessary dividing, the cricoid cartilage. The tracheal opening should be sufficiently large to admit the tube quite easily. The incision is now held open with the dilators, and the silver tracheotomy tube introduced. A stitch or two may be placed in the skin, but it is best not to close the wound too securely in case the tube is coughed out and has to be replaced; and lest subcutaneous emphysema should occur. On the second day the metal tube, if it cannot be left out altogether, should be replaced by a rubber one.

VII. RESPIRATORY DIFFICULTIES DURING ANAESTHESIA

No one is competent to give an anaesthetic who is not able to recognise and deal with the various accidents that may occur during its administration. Yet circumstances sometimes arise, particularly in operations of emergency, when the surgeon is

obliged to entrust the anæsthetic to an inexperienced person. He must, therefore, be prepared to give advice and assistance in case of difficulty.

When a patient under an anaesthetic stops breathing, the first thing to do is to ascertain whether there is any obstruction of the air-passages. Such an accident is most often due only to the falling back of the tongue, in which case it is usually sufficient merely to push the lower jaw forward, or if that fails to give relief, the tongue forceps must be used. Less frequently some foreign body will have found its way into the pharynx or larynx, such as artificial teeth, mucus, vomitus, or blood. If any of these causes is present the mouth must be opened with the gag, the head thrown back over the end of the table, and a digital examination of the pharynx made. It should be remembered that the opening of the mouth too widely by means of a gag may of itself be sufficient to cause considerable difficulty of breathing. If the obstruction cannot be removed, tracheotomy must be performed. Sometimes the obstruction is due to oedema of the larynx, as has already been described under

eellulitis of the neek. Or it may oecur during an operation for goitre, when one or other of the measures deseribed under that heading is to be adopted. If there is no obstruction, or if an obstruction having been removed no respiratory efforts are being made, artificial respiration must be resorted to, and stimulants administered hypodermieally.

Artificial respiration. The patient's head is to be thrown well over the end of the table and supported in this position. Having seen that the airway is free by opening the mouth with a gag and drawing the tongue forward with foreeps, the operator grasps the patient's elbows, and draws the arms first outwards and then inwards well above the head. He then reverses the movements, and, when the ehest is again reaehed, makes pressure upon it. At this moment an assistant may help the expiratory phase by making pressure upon the lower ribs. These movements are to be earried out slowly and regularly, each eomplete cycle oeeupying about three seeonds, and should be persisted in until some voluntary respiratory effort is deteeted,

or until the heart's action has ceased completely. Whilst the artificial respiration is being carried on hypodermic injections of ether and strychnine should be given: ice may be applied to the chest, and any other methods of stimulation which may be at hand resorted to. In children especially, a powerful stimulus can be applied to the respiratory centre by the simple device of stretching the sphincter ani.

CHAPTER IX

ACUTE AFFECTIONS OF THE URINARY SYSTEM

RETENTION OF URINE

Apart from disease or injury of the nervous system, the causes of urinary retention are obstructive, and may be due to acute urethritis, stricture, prostatic enlargement, rupture of the urethra or the impaction of a foreign body. In women the comparatively rare event of urinary retention is brought about by displacement of the gravid uterus, and may as a rule be readily relieved by manipulation of that organ. It is occasionally due to the impaction of pelvic tumours.

(a) *Acute urethritis*

If acute urethritis be the case, the actual mechanism is muscular spasm superadded to the swollen

condition of the mucous membrane. It must be remembered that the passage of a catheter, besides being attended by intense pain, is also likely to be followed by extension of the infection to the deep urethra, to the bladder, the prostate, or the epididymis. It is, therefore, to be rigidly avoided.

A dose of morphia followed by a hot hip-bath should first be tried, and this will usually be found efficient. Should these measures fail, however, there still remains an alternative to the passage of a catheter, namely suprapubic puncture. There is little doubt that the risk to the patient is less in this procedure, which, if carried out aseptically may be said to be devoid of danger, than in pushing back infective material into the deep urethra and bladder with a catheter.

Operation. The pubes having been shaved and thoroughly cleansed, a small-sized, sterile trocar and cannula entered in the mid-line immediately above the symphysis as close to the bone as possible. There is no need to use an aspirator. Directly the trocar is withdrawn the urine, being under great pressure, will escape readily. When

it has ceased to run, the cannula is withdrawn and the little wound sealed with collodion.

The relief of the congestion at the neck of the bladder will usually enable the patient to void his urine naturally afterwards. He should be kept in bed for a few days, upon a light diet, thoroughly purged, and treated with such drugs as hyoscyamus and buchu.

(b) *Stricture*

Retention due to stricture of the urethra is usually due, not to the stricture alone, but to muscular spasm or engorgement of the mucous membrane superadded to the organic stenosis. It may be treated in a variety of ways, but the simplest should always be preferred. Frequently it is sufficient to place the patient in a hot bath, and encourage him to pass water in the bath. Failing this, catheterization should next be tried, and if properly persisted in will rarely fail. It is surprising what a large-sized, silver catheter can sometimes be passed, for acute retention is frequently the result of spasm superadded to a stricture of large calibre. It is, therefore, best always to begin with a No. 8

catheter. The smallest silver instruments are dangerous even in practised hands, and should not be used: the smallest soft catheters may be tried, but will frequently be found useless.

Before proceeding to operative measures the Gouley catheter should always be tried, and tried patiently. The whalebone guides used with this instrument are of such consistence that, while possessing sufficient resistance, they are not rigid enough to produce a false passage. Several should be passed in succession as far as the face of the stricture. A little manipulation with each in turn will usually succeed in causing one or other of them to enter the stricture. The rest should then be withdrawn, and the silver Gouley catheter passed along the guide. With this alone amongst rigid urethral instruments a little force may be employed, because, with the guide safely through the stricture into the bladder, there is no risk of the instrument being forced through the urethral wall.

Should the Gouley catheter fail, it is good treatment to perform suprapubic puncture. The engorgement will subside when the distension of

the bladder has been relieved, so that it will probably be possible to pass a catheter soon afterwards. A catheter can often be passed when the patient is under an anaesthetic, because then the factor of urethral spasm is overcome. Catheterization under the anaesthetic should therefore always be tried before any cutting operation is resorted to.

All operations which involve opening the urethra are to be avoided, as well in the treatment of urgent retention as in the deliberate attempt to cure a stricture, lest an intractable urinary fistula should result. Cock's perineal puncture is an operation simple and even dramatic in its performance, but attended by serious risks and a tedious convalescence. It should therefore be used only as a last resort when all other measures have failed.

Operation. The pubes and perineum having been shaved and cleansed, the patient is put up in the lithotomy position. The forefinger of the left hand is then to be introduced into the rectum until its tip rests against the apex of the prostate. A long-bladed scalpel is next entered an inch in front of the anus, with its edge forward, and thrust

inwards towards the tip of the left forefinger, keeping all the time exactly in the middle line. As soon as the knife enters the distended urethra behind the stricture the urine will escape in a forcible stream. The finger must then be withdrawn from the rectum and cleansed. It is a good plan to employ a rubber glove for the first part of the operation, which can be taken off at this stage. A director is now passed along the knife into the bladder, and, the knife having been removed, a large-sized, gum-elastic catheter is introduced into the bladder, guided by the director, and secured in position with tapes.

After-treatment. The catheter is attached to a long piece of rubber tubing by means of which the urine is drained into a vessel at the side of the bed. In two or three days the catheter is to be removed, and the stricture dealt with either by internal urethrotomy or dilatation.

(c) *Prostatic obstruction*

(i) Retention due to *senile enlargement* of the prostate can almost invariably be relieved by the

catheter, provided that the proper instrument is used and that the anatomy of the distorted urethra is kept in mind. It should be remembered that the urethra in these cases is longer than normal, besides being more curved, and that therefore an ordinary sized catheter, even when it has sucessfully passed along the urethra, may fail to withdraw urine merely because it is not long enough to enter the bladder. In prostatic cases the small silver or ordinary olive-headed catheters should never be used. The failure to which they are doomed will probably be attended by urethral haemorrhage, and possibly followed by extravasation of urine. The catheter *par excellence* is the No. 8 or No. 10 silver prostatic catheter, which is specially long and provided with a much larger curve than is an ordinary catheter. This instrument, especially when aided by a finger in the rectum which pushes the beak forward, will rarely be found to fail. The black coudé or bicoudé catheter may also be employed, but it is rather less likely to be successful than the large silver instrument. Should these measures fail, an anaesthetic must be given, and

another attempt made to pass the catheter. If even then instrumentation is not successful, a suprapubic puncture may be performed.

If, however, the patient is known to have cystitis, and the proper means are at hand, suprapubic cystotomy may be advantageously performed. This allows a digital examination to be made for stone, which not infrequently complicates prostatic enlargement, and an opinion can be formed as to the advisability of performing prostatectomy at a later period. It also permits drainage and efficient lavage of the bladder.

(ii) *Inflammatory enlargement* of the prostate sometimes causes retention of urine. These cases are usually instances of acute gonorrhoeal prostatitis, or abscess of the prostate associated with some septic condition of the urethra or bladder. In the former, a hot hip-bath will usually make the patient succeed in passing water, but if that fails, a soft rubber catheter may have to be passed. In abscess of the prostate the catheter will generally be necessary, and it is probable that its use will be followed by evacuation of the abscess per urethram. If

not, the abscess will require to be opened by the perineal route. For this purpose an incision is to be made in front of the anus, in the mid-line, and, assisted by a finger in the rectum, a pair of sinus forceps is pushed into the perineum until the pus is reached. The opening is then enlarged, and a drainage tube inserted.

After the relief of obstructive retention it is not uncommon for the patient to be unable to void his urine naturally for a day or two or even longer, this disability being due to atony of the bladder, the result of over-distension.

(d) *Retention due to urethral and vesical injury*

These conditions are dealt with in the chapter on perineal injuries.

(e) *Foreign bodies in the urethra*

A stone descending from the bladder, or some object wilfully introduced into the meatus, may become impacted in the urethra and cause a partial or complete obstruction to the flow of urine. It is important to remove such an obstruction at

the earliest possible moment, otherwise ulceration will occur, threatening the patient with peri-urethral abscess and extravasation. A large number of forceps and other instruments have been devised for the purpose, but it is often a task of the utmost difficulty to grasp a smooth, slippery object lying in so confined a space as the urethra. If a reasonably patient attempt with forceps has failed, and it is impossible by external manipulation to move the foreign body, then operation should be proceeded with.

Operation. An incision is made over the object to be removed, in the mid-line, and the urethra opened. After the foreign body has been extracted, the little wound in the urethra is sutured with catgut over a catheter, and the skin wound left open. The catheter should be retained for a week.

If the foreign body is a stone which is placed very deeply in the urethra, it is sometimes advisable to push it back into the bladder and to remove it subsequently either by lithotrity or by suprapubic cystotomy.

EXTRAVASATION OF URINE

Closely related with the subject of retention is that of urinary extravasation, which may rightly be regarded as one of the most pressing of surgical emergencies. In spite of the seriousness of the condition, especially if cystitis is present, it is surprising how apparently desperate cases can be saved by energetic treatment. The most favourable cases are those due to urethral injuries in the young and previously healthy ; the least favourable are those which result from obstruction in the old and debilitated, when the urine is septic.

Treatment. The first indication is to provide free drainage for the bladder and to prevent further extravasation ; the second is to provide free drainage for urine that has escaped into the tissues.

The first object is attained in traumatic cases by cutting down upon the urethra, and suturing it over a catheter ; in stricture cases by division of the stricture and tying in a catheter ; and in prostatic cases by suprapubic cystotomy.

The second object can only be attained by free

incisions through the deep fascia wherever the urine has become extravasated. Bath treatment, unless contra-indicated by some very weighty reason, is only second in importance to the operation, and should be begun as soon as possible.

ACUTE CYSTITIS

The symptoms of this condition are intense hypogastric pain and tenderness, with an almost continual urgent desire to pass water. The constitutional symptoms are those of general malaise, but they are not usually severe. The urine is neutral or alkaline, contains pus, and may contain blood, giving rise to the condition known as ' prune-juice urine '.

Treatment. The important thing to remember is that no attempt must be made to irrigate the bladder. The inflammation will usually subside in a few days under proper general treatment. It is best to keep the patient in bed upon a milk diet, giving saline aperients and such drugs as hyoscyamus and buchu. Hot hip-baths will be found to give great relief.

SUPPRESSION OF URINE

Suppression of urine, which would otherwise necessarily prove fatal, can sometimes be relieved when it is due either to acute nephritis or to the simultaneous presence of calculi in both kidneys.

In either case the operation aims at relieving tension within the kidney capsule so as to permit of the urinary secretion being re-established.

Operation. The patient lies as nearly as possible prone, with an air-pillow so placed beneath the abdomen as to straighten out the natural concavity of the lumbar spine. An oblique incision is made outwards from the edge of the erector spinae a little below and parallel with the last rib. The muscles and fasciae are usually divided in the same direction, and the perirenal fat exposed. With the finger the kidney is then brought up into or, if necessary, out of the wound and stripped of its loose, fatty enevelope. If the condition is one of acute nephritis, the fibrous capsule is to be incised along the whole length of the convex border of the organ, and stripped off from the subjacent

renal tissue. The kidney is then replaced, a gauze drain inserted, and the wound partly sutured. The operation may, if thought advisable, be repeated on the other side. If the suppression is due to calculi, the kidney must be incised along its convex border, and the stones removed. The bleeding is usually very free, but it can be checked either by plugging or by passing two or three sutures of stout catgut through the whole thickness of the organ, and tying them tightly. The wound should be plugged with gauze, and only partly closed, so as to allow of the escape of urine.

CHAPTER X

INJURIES OF THE NECK

I. CUT THROAT

The gravity of this injury depends chiefly upon whether the air-passages have been opened or a large vessel wounded. The latter complication is an unusual event, and when it does occur it generally proves rapidly fatal. In many cases the incision does not open into the air-passages at all, the injury then amounting to nothing more than a wound of the soft parts, to be treated on general lines.

When the cut has gone more deeply it may be found to have passed

(i) Through the thyro-hyoid membrane, opening into the pharynx.

(ii) Through the thyroid cartilage, into the larynx.

(iii) Below the larynx into the trachea.

(iv) Above the hyoid bone, into the root of the tongue.

The immediate dangers are those of *haemorrhage* and *suffocation*, the latter being brought about by blood or vomitus finding its way into the air-passages. There is also, as a rule, a profound degree of collapse out of proportion to the extent of the wound or the amount of blood lost, and occasioned largely by the shock to the nervous system of the suicide or the victim of a homicidal attack.

The more remote dangers are those of *sepsis*, namely, septic broncho-pneumonia, secondary haemorrhage, and cellulitis.

Treatment. As a rule, immediate operation is indicated. The general condition is liable to improve under the anaesthetic.

If the haemorrhage has ceased, and dyspnoea is the most prominent symptom, tracheotomy should be performed as a preliminary measure: indeed, it is best in most cases to open the trachea, and to keep a tube in for a few days afterwards. Some-

times the wound itself, if situated below the larynx, affords the best position for the introduction of a tracheotomy tube.

The haemorrhage may be in progress, or may recur with the disturbance attendant upon washing, or by the increased blood-pressure produced by the stimulation of warmth or drugs.

All bleeding-points should be secured, and the wound and surrounding skin cleansed as thoroughly as possible, great care being taken that no foreign material is allowed to get into the air-passages.

The next care is the suture of the wound. The opening into the air-passages, unless used for a tracheotomy tube as suggested above, is to be closed as securely as possible with catgut sutures. It sometimes happens that a calcified thyroid cartilage has to be dealt with, in which case it is necessary to bore a hole through the cartilage with a fine drill in order to be able to pass the sutures.

Any layers of muscle that can be identified are then to be sutured loosely with catgut, and the wound plugged with gauze. If the skin incision

is extensive, it may be very loosely sutured. Unless a free exit is provided for discharges, emphysema and spreading suppuration are likely to ensue, which may travel widely in the cellular tissue of the neck and mediastinum. If much blood has been lost, saline infusion is indicated.

After-treatment. The patient must be put back to bed with hot bottles, and protected by a tent in which the air is kept moist by means of a steam-kettle. Stimulants are to be given freely. He must, for the first few days, be the sole care of a nurse, and after that period should be vigilantly watched by an attendant, lest he again attempt self-destruction.

The feeding may be a matter of difficulty. If the cut has passed above the hyoid bone, severing the muscles of the tongue, swallowing may be impossible; if the pharynx has been opened, food may pass into the wound. Such cases are, therefore, to be fed by means of a tube passed either through the nose or through the mouth.

II

Other injuries of the neck, such as bruising from any form of violence, or stabs and gunshot wounds, are to be treated on general principles. *Haemorrhage* must be arrested by ligature, after freely opening up and enlarging the wound.

Dyspnoea, from laryngeal ecchymosis, or from the escape of air into the cellular tissue, such as is likely to occur when the air-passage has been wounded, must be relieved by tracheotomy, or, if circumstances permit, by intubation.

If the *oesophagus* has been opened, the wound leading to it must be enlarged and free drainage provided. The patient must be fed either per rectum or with a stomach tube for a few days, when the wound will be found to close spontaneously.

CHAPTER XI

INJURIES OF THE CHEST

The thorax and its viscera may suffer injuries of almost endless variety from the same kinds of accident as affect the abdomen, namely, contusions and penetrating wounds. As in the case of the abdomen, the viscera may be lacerated by the fractured ends of ribs, without external wound.

Many of these injuries are immediately or speedily fatal, whilst others are of such rarity that the discussion of them would serve no useful purpose. Attention will, therefore, only be called to the diagnosis and treatment of such thoracic injuries as are of common occurrence and are amenable to surgical treatment.

I. CONTUSIONS

Under this heading will be considered such injuries as may be caused by ' buffer accidents ',

being run over, heavy bodies falling upon the chest, severe blows, and violent flexion or extension of the trunk. The most prominent symptoms of such injuries are pain, dyspnoea, rapid pulse, pallor, sweating, and general distress. There may also be cough and haemoptysis.

Method of Examination

(*a*) It is first essential to make a careful examination of the *abdomen*, as indicated in the chapter on abdominal injuries ; because the upper abdominal viscera, being largely under the shelter of the ribs, are liable to injury in crushes of the chest. Lacerations of the liver, spleen, and kidneys, in particular, are apt to be associated with fractures of the lower ribs.

(*b*) The *spine* should also be examined, particularly with a view to ascertain whether there has been any injury of the spinal cord.

(*c*) Note whether the respiratory movements are less marked in one part of the chest than another.

(*d*) Ascertain by palpation whether any ribs are fractured, and whether surgical emphysema is

present. The symptoms of fracture of a rib are: an acutely tender spot, increased pain on attempting to take a deep breath, and crepitus which may be heard more distinctly with the assistance of a stethoscope. The presence of air in the subcutaneous tissues is manifested by the appearance of a soft swelling which conveys to the fingers a sensation of crackling that is quite characteristic.

(*e*) Examine by auscultation and percussion for the presence of gas or fluid in the pleural cavity, namely, pneumothorax or haemothorax. Either of these collections may cause displacement of the heart. The predominant signs of the former are hyper-resonance, amphoric breathing, the 'coin sound', and distension of one side of the chest; with the latter there are dullness, distant or absent breath sounds, and loss of vocal resonance. The two conditions may be combined, blood accumulating in one part of the pleural cavity with air above it.

(*f*) Examine the heart both by percussion and auscultation. An increased area of cardiac dullness may indicate haemorrhage into the pericardium,

especially when associated with a muffling of the cardiac sounds. Displacement of the heart will point to an accumulation of fluid in the pleural cavity.

(*g*) The presence of haemoptysis indicates laceration or contusion of the lung.

(*h*) Examine the urine. Haematuria will indicate contusion or laceration of the kidney.

Complications

(*a*) *Fractured ribs.* The fracture of two or three ribs, without any injury to the subjacent viscera, is, in the young and healthy, an accident of no great importance. No special treatment is required beyond rest in bed for a few days, and strapping or bandaging of the chest. But in the aged, the obese, the alcoholic, and the subjects of visceral disease the fracture of even a few ribs is a most serious accident, liable to be attended with grave pulmonary complications. If many ribs are fractured there may be considerable embarrassment of respiration and cyanosis, in which case the removal of from twenty to fifty ounces of blood

by venesection will be found to afford very great relief. The operation is performed as follows.

Venesection. A bandage is to be applied to the upper arm sufficiently tightly to obstruct the venous but not the arterial circulation. The skin over the front of the elbow is to be thoroughly cleansed, and the most prominent vein opened by thrusting a sharp knife into it, the side of the blade being kept parallel with the skin surface, and cutting outwards through the skin. The blood is to be received into a measure-glass, and the amount removed must be sufficient to give relief without causing faintness. During the operation the patient should be made to sit upright so that any tendency to syncope can be at once detected. The rate of blood-flow can be increased if desired by the time-honoured device of causing the patient alternately to flex and extend the fingers upon a ' barber's pole '.

(*b*) *Subcutaneous emphysema* is only of importance in indicating a wound of the pleura or lung. It usually calls for no treatment beyond that required for the fractured ribs that have caused it, and it

will, if the patient recovers, subside spontaneously. Any attempt to relieve it by multiple punctures usually proves to be a futile proceeding.

(*c*) *Pneumothorax.* A laceration of the visceral pleura may be of such a nature that during expiration air enters the pleural cavity, but is unable to escape during inspiration. In these circumstances the pleural cavity rapidly becomes distended, and the lung collapses, causing extreme dyspnoea and requiring prompt measures for its relief. This is readily obtained by puncturing the chest wall with a large trocar and cannula, when the air in the pleural cavity will escape and the lung expand. This operation may have to be repeated. But in slight degrees of pneumothorax, where there is no special embarrassment of respiration, it is best to take no active steps, as the air will gradually become absorbed.

(*d*) *Haemothorax.* Haemothorax may occur either with or without external wound, and the blood may be derived from the lung, or from an intercostal or internal mammary artery. But it rarely happens that the bleeding is sufficiently severe to require

operation. In the slighter cases the blood will gradually be absorbed. It is only when the amount is very large, or when sepsis has supervened and produced a pyo-haemothorax, that operation is necessary.

(*e*) *Laceration and contusion of lung.* This accident is almost always followed by haemoptysis, which may be so severe as to prove speedily fatal, or may amount to little more than the expectoration of a little blood-stained sputum. Unless accompanied by haemothorax or pneumothorax, or followed by empyema, there is little to be done beyond absolute rest, applying an icebag to the side, giving ice to suck, and morphia subcutaneously. Such injuries, unless severe enough to be rapidly fatal, are, as a rule, readily recovered from. The outlook is, however, grave in old people and in the subjects of alcoholism and visceral disease.

(*f*) *Haemo-pericardium.* If, from an increased area of cardiac dullness and an embarrassed action of the heart, this condition is recognised, it may be relieved by making a free opening into the pericardial cavity.

II. WOUNDS OF THE CHEST

Bullet wounds, stabs, compound fracture of ribs, and such-like injuries may or may not penetrate the thoracic cavity. It is first necessary to ascertain whether in a given case one has to deal with a wound of the chest wall only, or with a penetrating wound. As a rule the condition is sufficiently obvious, but in cases of doubt it may be necessary to enlarge the external wound and explore with the finger.

Most cases of stabs and bullet wounds, unless accompanied by some complication, are perhaps best left alone, the surgeon contenting himself with cleaning up the wound, applying a dressing, and carefully watching for further symptoms.

As with contusions, so with penetrating wounds of the chest, the possibility of simultaneous injury to the abdominal contents must be borne in mind. The same examination is required as has been described for chest injuries without external wound.

Complications

(*a*) *Haemorrhage.* This may take place :—

(1) Externally, from an intercostal artery or from the lung. In the former case the blood escapes in jets corresponding to the heart-beat ; in the latter it is forced out during expiration and is frothy.

(2) Into the pleural cavity, either from the lung or from a parietal vessel.

(3) Into the air-passages.

In the first case the wound must be enlarged by resecting one or more ribs. If the haemorrhage comes from a parietal artery, this must be tied ; if from a wound of the lung, the pleural cavity must be cleared of blood and clot, the visceral pleura sutured to the parietal wound, and the tear in the lung plugged with sterilised gauze.

Haemoptysis is to be treated on the lines indicated above.

(*b*) *Haemothorax and pneumothorax.* These are to be dealt with exactly as if they were present without external wound. There is, however, with

a penetrating wound, mueh greater danger of the onset of septie complieations, and the formation of an empyema.

OPERATIONS OF URGENCY UPON THE THORAX

(1) *Drainage of the pleural cavity*

If there is an external wound, this should be enlarged. If no sueh guide exists, the opening is to be plaeed in the most suitable position for drainage, namely, towards the upper level of the dull area, and in the mid-axillary line. If too low a level has been taken, as soon as the fluid is evacuated the diaphragm rises in such a manner as to tilt the inner end of the drainage tube upwards, and so produce an oblique track.

When the breathing and the heart's aetion are embarrassed owing to a large accumulation of fluid in the pleural cavity, considerable danger attends the administration of an anaesthetic; especially as the patient is obliged to lie upon the sound side during the operation, a position which still further interferes with respiration. This danger

may be minimised in two ways, either by drawing off some of the fluid with an aspirator before administering the anaesthetic, or by employing a local anaesthetic. The skin can be rendered anaesthetic by the subcutaneous injection of one or two drachms of a 4 per cent. solution of eucaine, and the remaining steps of the operation are rendered comparatively painless by irrigating the wound from time to time with the same solution.

An incision, some four inches long, is made over and in the line of a rib, and is carried down to the bone. The periosteum is then stripped off with an elevator, carrying the intercostal vessels with it, and a piece of rib, not less than three inches long, is removed with bone-cutting forceps. The parietal pleura is next incised in the direction of the wound, and the fluid allowed to escape. Beyond introducing the finger and gently removing any pieces of fibrin, such as are often present, nothing further should be done; the cavity must on no account be irrigated with any fluid. Many forms of 'empyema tube' have been invented, but nothing is more satisfactory than a large piece of

ordinary rubber tubing stitched to the edge of the skin. It must have several large holes cut in its wall, and should only be long enough just to project beyond the chest wall into the cavity.

After-treatment. The abscess cavity which constitutes an empyema depends very largely for its obliteration upon the expansion of the lung. This can be assisted very materially by causing the patient to expire against a resistance, by some such device as blowing into an air-bag, an exercise which should be performed regularly several times a day. When drainage has been in progress for some days, and it is certain that no communication exists between the pleural cavity and the air-passages, a great deal of good can be done by causing the patient to lie in a boracic bath for from half an hour to an hour daily. By this means the empyema cavity is rendered sweet, and toxic absorption is minimised.

(2) *Drainage of the pericardium*

This operation may be necessary for the removal of pus or of blood. It is best performed by removing

a portion of the fifth left costal cartilage, in the manner described above for dealing with pleural effusions. It is best to secure the pericardium to the edge of the wound before opening it, to prevent the pus from escaping into the mediastinal tissues.

If the effusion is not purulent, or if it is desired to draw off some of the fluid either for diagnostic purposes or as a preliminary step before opening the pericardium, the trocar and cannula is to be introduced at a point one inch from the sternal margin, in the fifth left intercostal space.

(3) *Drainage of a pulmonary abscess*

This operation may have to be performed for the drainage of an abscess that has resulted from the presence of an inhaled foreign body in a bronchus. The pleural cavity is opened, after resection of portions of one or two ribs, in the manner above described. The visceral pleura is then carefully stitched to the parietal pleura all round the proposed opening in the lung. If the case is not urgent the rest of the operation may be proceeded with a few days later, when the pleural cavity will have been

shut off by adhesions ; but there is little advantage to be derived from a two-stage operation. The abscess cavity must next be located by means of a large trocar and cannula, the track of the trocar then enlarged by means of dilating forceps and the finger, and a drainage tube inserted. On no account is the cavity to be irrigated. If haemorrhage from the lung tissue is free, the wound must be packed with gauze strips, and the drainage tube inserted later.

CHAPTER XII

INJURIES OF THE NERVOUS SYSTEM

THERE are many cases of injury to the nervous system which require immediate operation in order to save life, and many more in which the delay of even a few hours may cause irreparable mischief. For example, the immediate suture of a divided nerve is followed by far better results than if the operation is delayed; and it can scarcely be doubted that some cases of fracture of the spine could be saved by prompt action, which now are allowed to die untreated, or in which laminectomy is performed as a forlorn hope some weeks after the accident.

Injuries of the nervous system may be classed as cerebral, spinal, and peripheral; and under each of these headings will be discussed those injuries which may be regarded as surgical emergencies.

I. INJURIES OF THE BRAIN

Intimately associated with injuries of the brain is the subject of fracture of the skull. There is, however, no constant relation between the two in point of severity, for serious lesions of the brain may follow accidents in which the skull is not fractured, and, on the other hand, extensive fractures of the skull are sometimes sustained without giving rise to any cerebral symptoms. Again, severe cerebral symptoms may attend an injury which causes no gross lesion of the brain, as in the functional condition known as concussion, and it must be remembered that every gradation exists between this condition and the most extensive lacerations of the brain substance.

One great difficulty which frequently arises is that of distinguishing between cases in which the cerebral symptoms are due to the injury, and cases in which scalp wounds or even fractures of the skull have been sustained in consequence of a fall due to sudden loss of consciousness from some totally different cause. For example, the

subject of a cerebral embolism may, in falling, sustain a fracture of the skull. If a clear history from a reliable witness is obtainable, the problem is considerably simplified. But it frequently happens that no such assistance is available, in which case the diagnosis must rest upon such evidence as can be obtained by a systematic examination of the patient.

Method of determining whether the head injury is primary or secondary

In all such cases the following routine examinations must be made :—

(i) Note any special point about the build or appearance of the patient, such as are commonly associated with the alcoholic, or the coarse features of the epileptic. Note also the smell of the breath, as this may give a clue to such conditions as narcotic poisoning, or diabetes. It cannot, however, be too strongly insisted that the smell of alcohol is of no value whatever, for it is almost certain that the drug will have been poured into the patient's mouth

by some well-meaning amateur before the arrival of the medical man.

(ii) *Consciousness.* Ascertain whether there is any response at all to such stimuli as loud noises, pungent odours like ammonia, pressure upon accessible sensory nerves, or the application of the Faradic current.

(iii) Note whether or not the urine or faeces have been passed. This sometimes occurs in concussion, but more frequently, perhaps, in the epileptic.

(iv) Examine the eyes—

(*a*) as regards the condition of the pupils. Inequality would indicate some unilateral lesion. Widely dilated and equal pupils are associated with general compression; narrowly contracted and equal pupils with narcotic poisoning, or pontine haemorrhage. Failure to react even sluggishly to the stimulus of light indicates an organic as distinct from a functional lesion.

(*b*) as regards the presence of squint or of conjugate deviation, either of which will point to some localised lesion, whether traumatic or pathological.

(c) as regards the presence of optic neuritis. Some cases of cerebral tumour produce sudden loss of consciousness, and the presence of optic neuritis would point to the possibility of such a cause.

(v) Examine the ears. This investigation may reveal chronic disease which would suggest the possibility of an intracranial abscess or of meningitis. Or blood may be found in the meatus, pointing to rupture of the drum or fracture of the base of the skull.

(vi) Test the urine for sugar, albumen, and casts; the presence of the first would suggest diabetic coma, and of the others, uraemia.

(vii) The tendon reflexes should be tested, but they are so variable in the conditions under consideration as to be, of themselves, of little value. In cerebral compression they tend to become less and less as the intracranial pressure increases.

(viii) The state of the muscular system as regards flaccidity or rigidity is of value, any difference in the two sides eliminating the toxic causes.

(ix) The presence of blood in a sample of cerebro-spinal fluid removed by means of a lumbar puncture

is said to indicate that the case is of a traumatic nature.

If such a routine examination is carried out, and the clinical picture so obtained is regarded as a whole, it should rarely be difficult to decide whether the cerebral symptoms are the cause or the effect of the injury.

If it has been decided that the symptoms are consequent upon the injury, the next point is to determine whether they are such as can be relieved by surgical intervention. In the first place, *concussion* has to be distinguished from *compression*, and this is, as a rule, not difficult. In concussion the loss of consciousness is sudden, and rarely so profound but that strong sensory stimuli will elicit some sort of response : the pupils are equal, and react, though sluggishly it may be, to light : the muscular relaxation has not the flaccidity of paralysis such as, in compression, is evidenced by stertorous breathing and blowing out of the cheeks : and no difference of muscular tone can be detected on the two sides of the body.

Many cases of gross injury to the brain are so

extensive as to require but a cursory examination to show that they are beyond the scope of surgical treatment.

There remain, therefore, a certain number of cases distinct on the one hand from those of concussion, contusion, and the slight degrees of laceration in which operative measures are not required; and, on the other hand, from those of a degree so severe as to be obviously hopeless. These can be broadly classified as follows :—

(i) Compound comminuted fracture of the skull, with or without laceration of the membranes and brain

Operation. No anaesthetic is required if the patient is unconscious, otherwise chloroform should be administered. The scalp should be shaved completely, and the skin thoroughly cleansed with soap, nail-brush, and hot water. It is best, in the next place, to turn down a large flap of scalp, including the wound, so as completely to expose the fractured surface. This done, all loose fragments are removed, and any depressed but unseparated pieces of bone raised to the level of

the surrounding skull. If the dura mater is torn, the wound in it must be exposed in its whole extent by removal of as much bone as may be necessary for that purpose, and any protruding brain matter must be cut away with scissors. The whole wound must now be cleansed with a copious stream of sterile saline solution at 110° F. No attempt should be made to suture the dura mater. The scalp flap must next be cleansed and replaced, any dirty, bruised edges of the original wound being freely cut away.

A large absorbent dressing is required, as a considerable amount of exudation is to be expected, particularly if the dura mater has been wounded.

(ii) Depressed fracture without scalp wound.

If there is no wound, the diagnosis of depressed fracture is not always easy, especially if no cerebral symptoms are present. Natural irregularities of the surface of the cranium may give rise to confusion, and a haematoma of the scalp is sometimes very difficult to distinguish from a depressed fracture. It may be laid down as a rule, with which few surgeons of the present day would quarrel, that

every depressed fracture, whether causing cerebral symptoms or not, should be operated upon. The only exceptions to this rule are the depressions met with upon the heads of young children, particularly of the newly born.

Operation. Unless the patient is profoundly unconscious, chloroform is administered, and the scalp shaved and cleansed. A flap is turned down so as to expose a large area of skull, including the depressed portion. A medium-sized trephine hole is next made close to the edge of the fracture, and through this a flat elevator is introduced between the bone and dura mater, and made to raise the depressed bone. When this has been done the dura mater elevator should be swept round over a considerable area between the bone and dura, to make sure that there are no fragments of bone still remaining. The wound is then closed.

(iii) Intracranial haemorrhage. Cases in which there is no external evidence of injury, but in which the symptoms point to intracranial haemorrhage, should be operated upon without delay.

The haemorrhage may proceed from some meningeal vessel which is inaccessible, in which case little can be done beyond opening the skull in order to relieve the cerebral compression. Frequently, however, the injured vessel is the middle meningeal artery or one of its branches, and the side to which the injured artery belongs will be indicated by the mode of onset of the symptoms.

Operation. A flap of scalp is turned down, with its centre corresponding to a point an inch and a half behind the external angular process, and the same distance above the zygoma. At this spot a disc of bone is removed with a medium-sized trephine, and the aperture enlarged as much as may be necessary by means of Hoffmann's or some other of the many forms of skull-cutting forceps.

The artery will thus be exposed, and if it cannot be ligatured in the ordinary manner, it must be secured by means of a stitch passed through the dura mater upon which it lies. If it should, as sometimes happens, be contained in a bony canal at this point, the canal should be plugged with aseptic wax. Any clot which may be lying between

the bone and dura mater is now removed by means of a blunt spoon under a stream of sterile saline solution, and the wound closed. No attempt should be made to replace the disc of bone removed, for it is far more liable to give rise to future trouble than to serve any useful purpose.

II. INJURIES OF THE SPINE

Although a rare condition, there is not the least doubt that concussion of the spine does occur. The cord may be subjected to such an injury as can, without producing any gross lesion, cause a complete temporary suspension of its functions. An instance observed by the writer illustrates this well. A gentleman, himself a medical man, diving from a height into shallow water, struck his forehead against the muddy bottom of the river, causing a violent extension of the neck. When removed from the water he was completely paralysed and anaesthetic from about the level of the fifth cervical segment downwards. There was no loss of consciousness. After a few minutes, sensation began to return, accompanied by tingling, and shortly

afterwards he could move his legs. Complete recovery rapidly ensued.

A similar accident may cause any degree of injury to the cord up to complete transverse severance within the theca. The cord may also be damaged by the pressure of fragments of bone such as may occur in fracture-dislocation of the vertebral column. Haemorrhage, either extra-thecal or intrathecal, may cause pressure upon the cord in precisely the same manner as an intra-cranial haemorrhage causes pressure upon the brain. In fracture-dislocation of the lumbar spine the cauda equina may be injured in a similar manner.

Treatment of fracture-dislocation of the spine

If the patient is seen shortly after the accident, he will usually be found to be in a collapsed condition, and so long as this state persists the nervous symptoms are apt to be misleading. The shock should be treated only by warmth in bed and morphia, stimulants being, if possible, withheld in view of the possibility of haemorrhage. When

the immediate shock has passed off, a careful examination should be made :—

(*a*) of the spinal column;

(*b*) of the cord symptoms;

(*c*) to ascertain whether any other injuries are present.

(*a*) *The spinal column.* In a muscular man it is sometimes difficult to detect even a gross displacement of the vertebrae. Any irregularity of the spinous processes, especially if accompanied by cord symptoms even of the slightest degree, should be looked upon with suspicion, remembering, however, that a spinous process or a lamina may be fractured without any interruption of the continuity of the vertebral column. A fracture through a single lamina may be sufficient to cause a haemorrhage large enough to produce symptoms of pressure upon the cord. Whenever possible a radiographic examination should be made. The absence, however, of any break in the continuity of the spinal column does not exclude the possibility of gross injury to the cord having occurred, because it is believed that, in the cervical region

especially, a dislocation may have occurred and become reduced by the time the examination is made.

(*b*) *The spinal cord.* In some cases the symptoms are those of a complete transverse lesion of the cord at the site of injury ; in others the interference with the conduction of the cord may be only partial. In any case a careful watch must be kept for any alteration in the level or completeness of the cord symptoms such as might indicate progressive haemorrhage.

(*c*) *Concomitant injuries.* So severe is the violence necessary to cause grave spinal injuries that other serious lesions may coexist, such as fractures of the ribs or pelvis, with laceration of the thoracic or abdominal viscera. The presence of any such concomitant injury would modify the line of treatment, and might at once contra-indicate any operation upon the spine.

The question of operation in spinal injuries

In determining whether or not operation is to be undertaken in any given case, the following points must be taken into consideration :—

(i) The age and general condition of the patient, and the presence or absence of other injuries.

(ii) The presence or absence of displacement of the vertebrae.

(iii) The level, the degree of completeness, and the progress of the cord symptoms.

It is difficult to lay down any definite rules, because no two cases are exactly alike, and each must be treated on its own merits. But the following general lines may be indicated.

(1) If the cord symptoms are those of a transverse lesion, found to be complete immediately after the accident, and there is no displacement of the vertebrae, it is probably useless to operate. This is especially true if the patient is a bad subject and other injuries coexist.

(2) If there is any deformity still present, and there seems any probability at all that the loss of conductivity in the cord is due to its being stretched over a displaced bone, and if there is no distinct contra-indication such as would be furnished by a severe concomitant injury, then the chance which operation offers, however small, should be given.

(3) Whether deformity is present or not, if the symptoms are those of an incomplete lesion, however trifling may be the evidence of conduction, operation should be performed.

(4) If the cord symptoms are incomplete, and after a few hours' observation are found to be progressive, the probability is that haemorrhage is in progress, and operation should be undertaken.

Operation. The mere reduction of a displacement by traction and manipulation is not to be recommended, except perhaps as a temporary measure in circumstances which do not admit of an open operation. It is unreliable as a means of relieving pressure upon the cord, is not devoid of danger, and would avail nothing if the pressure were due to haemorrhage or to a completely detached fragment of bone. The operation which should be carried out is as follows. The patient is anaesthetised with chloroform and placed upon the right side, semi-prone. A long incision is made with its centre corresponding to the site of injury, over the spinous processes, and the posterior aspect of the neural arches freely exposed by separation and

retraction of the dorsal muscles. The laminae are then partially sawn through near the articular processes, and the division is completed with Horsley's laminectomy forceps.

The removal of several neural arches is necessary in order to give a thorough exposure of the spinal canal, and to enable any blood-clot and loose fragments of bone to be removed. Any displacement of the vertebrae that may be present should be reduced by manipulation whilst assistants make traction upon the pelvis and shoulders. If the haemorrhage is intratheeal, the dura mater must be opened and the clot carefully removed. The wound is then closed, and the patient placed flat upon the back in bed upon a water-pillow. If a displacement has been reduced and tends to recur, it may be necessary to continue the traction upon the spine for several days by means of shoulder-straps fixed to the head of the bed, and a pulley-and-weight arrangement taking its purchase from a band around the pelvis.

The after-treatment consists chiefly of efforts to prevent the formation of bed-sores; the regular

use of the eatheter, when necessary, and the prevention of eystitis ; and daily massage and eleetrieal treatment of the paralysed museles.

III. INJURIES OF PERIPHERAL NERVES

A peripheral nerve trunk may be eompletely divided in an ineised wound, as so frequently happens in the ease of the median and ulnar nerves at the wrist ; or it may be so damaged by a severe eontusion or partial laeeration as to have its eonduetivity interfered with to an extent whieh will vary with the severity of the injury.

In the former elass of eases there should be neither doubt nor delay as to the line of treatment. The promptness with whieh the ease is dealt makes a eonsiderable differenee in the prospeet of reeovery.

In the latter elass eonsiderable diffieulties may arise. The exaet nature and extent of the injury may be diffieult to determine, and it may be doubtful whether operation affords any prospeet of improving the eondition : moreover, the nerve at the point of injury may be inaeeessible. It should not, however, be assumed that beeause there is

evidence of partial conductivity in the nerves, the prospect of recovery cannot be improved by operation. A large nerve trunk may be partly divided by a stab or bullet wound, and that divided portion may be capable of suture. On the other hand, the nerve may have been perforated by a bullet or otherwise damaged in such a manner as to cause no break in its gross anatomical continuity, and so present a condition which operation would not benefit.

It may, therefore, be laid down as a rule that in every case of complete division of a nerve trunk, suture should be performed as soon as possible after the injury; and that in cases of partial division, unless the nerve is anatomically inaccessible, exploration should be undertaken, and the case dealt with according to the condition found. If the continuity of the nerve trunk as a whole is found to be not interrupted, nothing further should be done. If, however, the trunk is partly divided, this portion should be sutured without interference with the rest of the nerve.

Suture of a divided nerve: operation

Inasmuch as primary union is of the utmost importance in these cases, the greatest possible attention must be paid to the cleansing of the wound, and every effort directed to secure asepsis. On no account should strong chemicals be brought into contact with the injured nerve, and as weak ones are valueless it is best to avoid their use altogether. The ends of the divided nerve having been found—for which purpose it is usually necessary to enlarge the wound—they should be accurately approximated with two or three sutures of fine silk or catgut carried on a round-bodied needle. The wound having been closed, the limb is fixed by suitable splints in such a position as to secure relaxation of the sutured nerve, and this position is to be maintained for ten days or a fortnight. The after-treatment consists in persistent massage and electrical treatment of the muscles supplied by the injured nerve.

CHAPTER XIII

INJURIES AND DISEASES OF THE EAR

I. FOREIGN BODIES IN THE AUDITORY MEATUS

Such bodies as beads, peas, and the like are not infrequently introduced into the meatus by children and the insane. The ear should always be first examined under a good light, and the exact position and size of the foreign body determined. In attempts at removal care must be taken that the foreign body is not pressed more deeply into the meatus, as, owing to unskilful manipulations, the tympanic membrane is sometimes injured, or permanent damage done to the meatal walls. The best method of removal is by intelligent syringing; a piece of rubber should be put on the nozzle of the syringe and introduced into the meatus, so as almost to touch the foreign body; a strong stream of water should then be projected along the upper

wall, whilst the canal is straightened out as far as possible by pulling the auricle upwards and backwards. If this fails forceps may be used, or some form of blunt hook, or a loop of wire, and if there is any difficulty in keeping the patient still an anaesthetic should first be administered. If by previous attempts at removal the foreign body has been forced more deeply in and attempts at removal by any of the previously-mentioned procedures have failed, it may be necessary to make an incision behind the ear and push the auricle forwards, separating the cartilaginous from the bony portion of the meatus. By this means free access is obtained to the bony meatus, and the foreign body can be removed with forceps or a wire snare. If necessary, a part of the bony meatus may also be removed by a mallet and gouge.

II. FURUNCLE OF THE EXTERNAL MEATUS

This is usually situated in that part of the cutis lying near the perichondrium or its superficial layers. It occurs often without any known cause in perfectly healthy individuals, or may be due to

injury to the meatus, as by the introduction of foreign bodies; or a hair follicle or sweat duct may be infected by pus coming from the middle ear.

The chief symptom is pain, increased by pressure on the ear or on movement of the lower jaw, often so intense as to prevent sleep; this is usually accompanied by a throbbing in the ear. If the furuncle becomes large enough to block the meatus there may be some deafness, but usually the hearing is good. Where the furuncle is situated on the posterior wall, there may be redness and oedema over the mastoid process, and at times the abscess extends over the mastoid but is usually subcutaneous. A high temperature is often present, reaching in some cases 102° or 105° F.

In these cases the diagnosis is made from that of acute mastoiditis by the fact that pain is caused by movement of the jaw, or by pressure on the auricle or on the tragus; by the presence of the swelling in the meatus; by the fact that the membrane is normal except for slight redness and dullness on the outer surface; by the condition of the hearing;

and by the fact that over the mastoid process if swelling be present it is due to oedema or a subcutaneous abseess. In aeute mastoiditis, on the other hand, there is no pain on movement of the jaw or on pressure of the auricle; the membrane is usually perforated or bulges forward; there is rarely swelling in the meatus, exeept when pus has made its way from the antrum along the vessels whieh run into the posterior superior wall; the hearing is diminished; the swelling over the mastoid proecss is due to infiltration of the dcep parts, and an abseess is nearly always beneath the periosteum.

It must not bc forgotten, howcver, that a furunele may bc prcsent at the same time as an aeute mastoiditis.

III. TRAUMATIC RUPTURE OF THE TYMPANIC MEMBRANE

This may occur (i) by direct pcnetration of a foreign body into the ear, (ii) by sudden eondensation of the air in the meatus, as by a box on the car, or sudden explosions, (iii) by extension of a fracture of the base of the skull.

In the first case the rupture is more frequently in the posterior part of the membrane, in the second it is more commonly in the anterior half, midway between the manubrium and the tendinous ring, and in the third case a fissure usually extends from the anterior or superior wall.

At the moment of injury a loud subjective noise is heard and a sharp pain is felt, followed by marked dizziness and tinnitus which may continue for some days. Bleeding is generally profuse, the blood coming from the ruptured vessels of the membrane and in the third class of case also from the fractured bones.

On examining the membrane soon after the injury the opening is seen to be irregular and its margins are covered with blackish-red extravasated blood. The disturbance of hearing is generally slight.

The treatment in uncomplicated cases is simply to close the meatus with a piece of wool in order to keep out dust; syringing is not advisable. Should the ear become infected, the ordinary treatment for suppurative otitis media must be carried out.

IV. ACUTE OTITIS MEDIA

(a) *Catarrhal*

This occurs usually in the course of an acute coryza, especially in children suffering from adenoids, and is characterized by inflammation of the mucous membrane lining the tympanum which becomes reddened and swollen, and may give rise to the exudation of a serous or a mucoid fluid into the tympanum. The patient has slight pain in the ear and complains of indistinctness of hearing, and of a feeling of fullness and numbness in the ear, as though water had been left in the meatus.

On examination of the drum it will at first appear reddened and inflamed with, in some cases, slight bulging outwards. Later, the redness disappears and the membrane appears granular owing to the shedding of particles of epithelium; if exudation be present in the tympanum it will be apparent through the membrane as a yellowish layer usually at the lower part. In the latter stages the membrane may be retracted, owing to the blockage of the Eustachian tube.

The treatment consists in the application of fomentations to the ear, and later, inflations to open up the Eustachian tube. In rare cases where the fluid in the tympanum persists, paracentesis of the drum may be necessary.

(b) *Suppurative*

This occurs most frequently in acute and chronic naso-pharyngeal catarrhs and during the acute specific fevers, especially scarlet fever, measles, and influenza. The disease usually begins with intense pain in the ear, which is most severe at night. Tenderness on pressure over the mastoid, especially at the apex, is very common, particularly in cases due to influenza; this persists until the escape of the pus. In adults there may be little or no rise of temperature, but in children the temperature may reach 104° or 105° F., and may be accompanied by vomiting, delirium, and convulsions. At times facial paralysis may occur. The hearing is markedly diminished and the patient often complains of subjective noise. The tympanic membrane at first appears injected, especially at

its upper part and along the handle of the malleus; later the whole membrane becomes reddened and oedematous, so that the handle of the malleus is not visible. Marked bulging of the drum, most commonly in the posterior and upper part, often occurs. Rupture of the drum may occur, usually about the third day after the onset of the inflammation, and with the discharge of the pus the pain subsides in uncomplicated cases.

At the early stages of the disease treatment consists in the application of hot fomentations. After the membrane has ruptured, the meatus must be kept clean by syringing with various antiseptic lotions, or by dropping in a solution of hydrogen peroxide, which should be retained for about five minutes. Special attention must be paid to keeping the perforation open until all discharge has ceased. In cases where the membrane bulges, with pain over the mastoid and marked constitutional symptoms, paracentesis of the membrane should be performed as early as possible to allow of the escape of the pus.

The *operation* is known as myringotomy, and is

performed as follows. In children and the timid a general anaesthetic is required, for which purpose ethyl-chloride or nitrous oxide gas will usually be sufficient. In others it is sufficient to drop some 10 per cent. cocaine solution into the ear a few minutes before the incision is made. As large a speculum as the meatus will admit is then introduced, and the membrane incised in the postero-inferior quadrant. Special knives are made for this purpose, but in an emergency a sharp-pointed tenotome answers the purpose admirably. After the incision frequent gentle syringing with hot water and the application of hot fomentations will be required.

V. ACUTE MASTOIDITIS

This comes on with marked pain in the ear which radiates over the side of the head ; it usually occurs some days after the onset of an acute suppurative otitis or at any time during a chronic otorrhoea, when it is often associated with a cessation or complete stoppage of the discharge. In children it is accompanied by headache, vomiting, high fever, sometimes rigors, a rapid pulse, and the other

signs of an aeute periostitis, but in adults it is not uncommon to find very little rise of temperature and a pulse-rate only slightly above the normal.

On examination in the early stages there is marked tenderness on pressure over the mastoid, espeeially over the apex; later there may be redness and infiltration of the soft parts, and at a still later stage an abseess may appear over the mastoid process. This is formed by the pus making its way through the outer wall of the antrum, or in young ehildren through the squamo-mastoid suture, as this is present in young children and sometimes persists till puberty. The abscess makes its way upwards and forwards, because the periosteum in that direetion is more easily separated from the bone than at other parts; the ear is thus pushed forwards and lies at a rather lower level than the other ear.

In rare eases a fistula may be formed on the inner side of the apex of the mastoid and open into the digastrie fossa, when an abseess will form in the neek beneath the sterno-mastoid muscle (Bezold's mastoiditis).

In almost all eases deafness is well marked,

though in rare cases, chiefly of tuberculous origin, the tympanum may be normal and yet the mastoid process be completely riddled with granulation tissue and pus.

In making the diagnosis one has to differentiate cases of acute mastoiditis from:—

(*a*) Glandular abscess over the mastoid process. This is done by the examination of the tympanic membrane and of the hearing, and in most cases the primary cause of the inflamed gland will be seen, usually on the scalp.

(*b*) Furuncle in the meatus. The presence of this is easily diagnosed by examination of the meatus and by the symptoms already described for this condition.

Operation for acute mastoiditis supervening on an ACUTE *otitis media*

A sufficient area of the scalp having been shaved behind the ear and the patient anaesthetised, the head is placed in a convenient position upon a flat sandbag. The incision commences close to the top of the attachment of the auricular cartilage to the scalp, passes

downwards in a slightly curved direction about half an inch behind the pinna, and terminates just below the apex of the mastoid process. The pinna is then pushed forward until the edge of the bony meatus is just exposed and is then held forward by means of a 'rake' retractor. By means of a gouge and mallet the outer wall of the antrum is removed, and such of the other cells as may be deemed to be infected opened up. The posterior wall of the bony meatus is not removed, neither is the tympanum interfered with. The operation is completed by plugging the wound and applying a dressing. At times, especially in cases due to scarlet fever, definite sequestra may be found, and must then be removed; and should the necrosis involve the deeper parts it may be necessary to perform the complete operation.

Operation for acute mastoiditis supervening on a CHRONIC *otitis media*

When the acute inflammation supervenes upon a chronic otorrhoea, so that the tympanic membrane has been more or less destroyed, and the ossicles

are carious, and the tympanum and mastoid process, especially the antrum, are extensively diseased, then a more radical operation becomes necessary. The antrum and mastoid cells are to be opened up thoroughly, as in the operation just described, and in addition the posterior wall of the bony meatus is to be chiselled away, together with the outer wall of the attic which is formed by the roof of the bony meatus. At the same time the tympanum is to be cleared with the curette of all granulations and what may remain of the tympanic membrane, together with the malleus, but the stapes should not be interfered with. In this manner the external auditory meatus, the tympanum, attic, mastoid antrum, and mastoid cells, are all thrown into one continuous cavity. The walls of this cavity are gouged away so far as may be necessary to ensure removal of all the carious bone. In so doing it may be found necessary to expose the lateral sinus and the dura mater of the middle fossa; no risk attaches to the exposure of these structures, provided that they be not accidentally wounded. The safety of the facial nerve is best

secured by remembering that, after running backwards in the upper part of the inner wall of the tympanum above the fenestra ovalis and below the horizontal semicircular canal, it turns abruptly downwards and forms the inner boundary of the narrow canal leading from the tympanum to the antrum, namely, the aditus ad antrum. The canal in which the nerve lies can be seen distinctly, and it is only by keeping its position in view whilst operating in its neighbourhood that it can with certainty be preserved from injury. When the bony operation has been completed the wound is syringed out and plugged. A plastic operation should also be performed on the posterior wall of cartilaginous meatus so that subsequent treatment can be done through the meatus.

After-treatment. Healing may be hastened by covering the wall of the cavity with a 'Thiersch' graft at a second operation (for details of which the reader is referred to works on operative surgery), but many of these acute cases will heal soundly if the cavity is carefully syringed and plugged daily.

VI. COMPLICATIONS OF ACUTE MASTOIDITIS

(a) *Extradural abscess*

There are no symptoms by means of which this complication can be definitely recognised, and it is often found unexpectedly in the course of the operation just described. If it is present, and the diseased bone is carefully removed by following out all nooks and crannies and carious spots, it can scarcely fail to be encountered. Before operation its presence may be suspected if the tenderness and oedema are situated beyond the limits of the mastoid process, and if, without any other signs of cerebral abscess, commencing optic neuritis is present. The situation of the pus is between the dura mater and the bone, and is more commonly found in the posterior than in the middle fossa, and is frequently situated in the groove of the lateral sinus. In these cases the dura may be covered with granulations or may be quite unaltered except for slight hyperaemia. In cases of chronic otorrhoea, especially if combined with a cholesteatoma, the abscess is more circumscribed and

the dura appears of a greyish-green colour and has a greater tendency to necrose.

(b) *Sinus Thrombosis*

In a neglected state of mastoiditis, infection may spread to the lateral sinus either directly, as when the pus of an extradural abscess bathes its wall, or by extending along some tributary vein. During the process of thrombosis, whilst there is still a current of blood flowing through the sinus, fragments of the infected clot are apt to become dislodged and carried into the circulation, thus causing the further complication of *pyaemia*. Sinus thrombosis may be recognised if, in addition to the other symptoms of acute mastoiditis there are rigors, intense headache, vomiting, and pain in the neck along the course of the jugular vein, although it must not be forgotten that such pain may be caused by a chain of inflamed glands. In a neglected case there may even be present in addition definite signs of pyaemia, such as effusion into joints or abscesses in the lungs. The treatment must be directed to the prevention of any further fragments of clot

entering the circulation, and this is accomplished by ligaturing the internal jugular vein. If the sinus thrombosis is recognised before operation, it is best to tie the vein before the mastoid operation is performed. But sometimes the condition is only diagnosed during the progress of the mastoid operation when the sinus is exposed. In such a case the vein must be tied afterwards.

Operation. An incision three inches long, with its centre placed opposite the cricoid cartilage, is made in a line extending from midway between the angle of the jaw and the mastoid process to the sternoclavicular joint. The deep fascia having been divided, the anterior border of the sternomastoid is defined, and the muscle retracted. The omohyoid may be seen and drawn downwards with a retractor. The carotid sheath thus exposed is opened, and the vein isolated from the carotid artery and vagus nerve. It is then divided between two ligatures, and the proximal cut end sutured to the upper angle of the wound. Any tributary veins that can be found above the division, particularly the common facial, should be ligatured.

The complete mastoid operation must next be performed as described above, and the removal of bone carried backwards so as thoroughly to expose not less than two inches of the sinus. The dura mater which forms its outer wall is next cut away, and the purulent clot evacuated. At this stage free bleeding may ensue, particularly if the thrombosis of the sinus was incomplete. This is readily arrested by plugging the sinus with a strip of sterile gauze pushed towards the torcular. The clot remaining in the vessel between the plug and the vein in the neck may be cleared away by syringing.

After-treatment. The whole large wound is left widely open, to be syringed and plugged daily. Pyaemic abscesses may have to be dealt with, and if the symptoms do not subside, trial should be made of an antitoxin injected subcutaneously. Unless the actual organisms concerned in the case are known, any antitoxin that may be employed must necessarily be used empirically. But as the majority of these cases are due to infection with some form either of staphylococcus or streptococcus, the serum selected should be either a multi-

valent anti-staphylococcic or a multivalent anti-streptococcic serum. If two or three large doses of the one produce no effect, then the other should be tried. In either case not less than 40 cc. should be given at intervals of from eight to twelve hours.

(c) *Cerebral abscess*

As a complication of mastoiditis, brain abscess is most frequently found in the temporo-sphenoidal lobe, and next to that in the cerebellum. Occasionally it is encountered accidentally during the progress of a mastoid operation: in such a case the membranes have become adherent on the one side to the abscess wall, and on the other to the diseased bone—most often a carious tegmen tympani. But as a rule a train of symptoms is superadded to those of the mastoid disease which enable a diagnosis to be made before the mastoid operation is undertaken. Sometimes, on the other hand, the symptoms of brain abscess only manifest themselves some days or even weeks after the mastoid operation has been performed.

The symptoms by which an abscess of this kind can be recognised are *general* and *focal*.

In the first group are headache, drowsiness, vomiting, slowing of the pulse-rate, subnormal temperature, and optic neuritis. The focal symptoms depend upon the situation of the abscess. The more prominent symptoms of temporo-sphenoidal abscess are weakness or paralysis of the opposite side of the body, due to pressure upon the internal capsule, and, if left-sided, some aphasia. Cerebellar abscess is indicated by inco-ordination, occipital headache, retraction of the head, and nystagmus, especially marked during movement of the eyes towards the affected side; there may also be an increasing slowing of the respiration until asphyxia results, in which case relief of pressure by evacuation of the pus becomes a matter of urgent necessity.

Operation. The operation for brain abscess complicating mastoiditis necessitates not only drainage of the abscess itself but also removal of the primary source of the infection. It is sometimes recommended that a separate opening should be made for the abscess, on the ground that there is less risk of infecting the tissues which have to be traversed in order to reach the abscess; if possible it

is better to evaeuate the absecss along thc course of infection. This, however, is not a point of great importance ; indeed, thc absecss frequcntly lics so elosc to the diseascd tcmporal bone that the double operation would bc impraeticable.

The mastoid operation having bcen completed and the lateral sinus exposed, the opening in the bone is to be enlarged either downwards and backwards, or upwards and forwards, according as to whether the abseess is judged to be below or above the tentorium. Information as to the position will be obtained by the appearance of the dura mater, whether whitish in colour, bulging, and non-pulsating, or not. The dura is next to be incised as close to the supposed site of the abscess as possible, and an ineision made with a scalpel into the brain tissue. Exploration by means of a trocar and cannula is not to be recommended, for it frequently fails to reveal the presence of pus even when, as is occasionally demonstrated in the *post-mortem* room, the instrument has actually entered the abscess cavity. Thc pus having bcen found, a finger is gently thrust through the incision in the cortex,

so as to enlarge it sufficiently, and a rubber drainage tube inserted and held in place by a catgut stitch passed between it and the edge of the dura mater.

After-treatment. The cavity is to be syringed out daily, and the tube gradually shortened until it can be omitted altogether. It is a good plan to pass a fine gauze wick down the tube. This allows the lumen to be cleared, at the next dressing, of thick pus and debris of brain tissue, without removing the tube from its track.

(d) *Meningitis*

The presence of definite meningitis of not too advanced a type should be no bar to the performance of the mastoid operation. Recovery ensued in a case of my own when, before operation, retraction of the head, slight swelling of the optic discs, and vomiting were present. Moreover, the symptoms of a localised extradural abscess, or even of a brain abscess, may simulate those of meningitis very closely. Unless the condition of the patient is clearly hopeless, the complete mastoid operation should be performed, and the dura mater opened.

CHAPTER XIV

INJURIES AND DISEASES OF THE EYE

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In this section the common injuries of the eye will first be considered, and afterwards the acute diseases which require immediate treatment.

I. INJURIES OF THE EYELIDS

In *contusions*, the swelling which follows may be limited by applying cold or an evaporating lotion, bearing in mind this caution, that a lead lotion must not be used where any abrasion of the cornea is present, lest a white deposit of lead carbonate be formed on the cornea.

Insect stings cause considerable swelling. The site of the puncture, if recent, should be touched

with liquor ammoniae to neutralize the acid poison, and hot fomentations applied.

Wounds of the lid should be treated on general surgical lines. Always consider the possibility of perforation and injury to the globe. Should the tarsal cartilage be divided, the cut edges should be brought together with a buried silk suture. If one of the canaliculi has been divided, an attempt should be made to find the end nearest the lachrymal sac and a fine silver probe should then be passed from the punctum along the whole length of the divided canaliculus and retained there, and the wound closed. If the levator palpebrae muscle has been divided, it should, if possible, be sutured.

II. INJURIES OF THE CONJUNCTIVA

Foreign bodies, such as pieces of cinder, frequently lodge in the conjunctival sac; they may be seen in the lower fornix by directing the patient to look upwards; or they may be found lodged under the upper lid, in which case the lid must be everted in order to remove them; while the lid is being everted, the patient is told to look downwards.

Wounds involving the conjunctiva may be brought together with fine silk sutures after irrigating the eye with sterilised normal saline solution, and a pad and bandage applied.

III. THE CORNEA

Abrasions of the cornea are often infected at the time of injury. The conjunctival sac should be irrigated with a warm normal saline, or boracic lotion, a drop of atropine solution (four grains to the ounce) instilled into the eye, and a pad bandage applied. The eye should be kept tied up for two or three days until the epithelium has grown over the abraded surface. The bandage may be reapplied two or three times a day, when the lids may be bathed with boracic lotion. Should there be any inflammatory condition of the lachrymal sac the danger of infection is much increased. In infected abrasions an ointment containing two grains of atropine and thirty grains of precipitated iodoform to the ounce, should be employed.

Foreign bodies on or embedded in the cornea require removal. A foreign body on the cornea

can be removed with a clean piece of blotting-paper after the use of a two per cent. solution of cocaine.

Foreign bodies in the substance of the cornea should be removed with an ophthalmic needle, or a spud, but preferably the former, as it causes less destruction of corneal tissue.

Operation. The eye being well anaesthetised with cocaine, the surgeon stands behind the patient who, seated in a chair, has his head steadied by means of a rest, or against the surgeon's chest. The patient is asked to open the eyes, and to look steadily at some object in front of him, so that the foreign body is brought well into view. This is aided by an assistant focussing the light from a lamp on the cornea, with a convex lens. The eye is steadied between the index and middle fingers of the left hand. In removing foreign bodies from the cornea it must be remembered that the resulting scar, if central, may seriously interfere with vision, and therefore it is advisable to work with the needle in a direction away from the centre of the cornea, as much as possible. This precaution also lessens the possibility of injuring the eye, in case

a nervous patient should move it during the procedure.

In removing a particle of *iron*, the brown ring formed round it should be gently scraped away. The eye should be irrigated and the same after-treatment adopted as described for abrasions.

The rarer case of a foreign body abutting on Descemet's membrane, or projecting into the anterior chamber, requires an instrument carefully passed behind it to prevent it slipping back into the anterior chamber, before its removal can be attempted.

IV. THE GLOBE

Injury of the globe by contusion may produce many serious conditions, and a thorough examination with the ophthalmoscope, as well as of the external conditions, is necessary before it can be definitely said that the eye is uninjured.

Haemorrhage

Haemorrhage into the *anterior chamber* (hyphaema) may be associated with iridodialysis or with laceration of the pupillary border of the iris.

In both these cases the eye should be tied up and rest enjoined. Cold compresses may be employed to relieve pain. In the former condition atropine is used; in the latter it is contraindicated.

Haemorrhage into the *vitreous*, which may perhaps be obscuring a ruptured choroid or a detached retina, requires similar treatment, and atropine should be used.

A *dislocation of the lens* may call for operative interference in the near future, especially if it is displaced forward or if the dislocation is subconjunctival.

A traumatic cataract may be produced by rupture of the lens capsule.

Penetrating Wounds and Ruptured Globe

In penetrating wounds two contingencies must always be borne in mind :—

(i) The possibility of infection.

(ii) The retention of a foreign body in the eye.

A foreign body remaining in the eye is always a potential source of sympathetic ophthalmia in

the other eye, and in the large majority of cases calls for removal. Such removal is easier before the foreign body becomes encased in exudate. If the foreign body throws a shadow with the X-rays, it can be accurately located, and if magnetisable can be removed with the electro-magnet.

In perforating wounds of the cornea the aqueous escapes, and there is great danger of prolapse of the iris. If this occurs, after the instillation of cocaine and irrigation the iris should be separated from any adhesions that may exist and the prolapsed part removed.

Even if prolapse does not occur, rest in bed, with the eye tied up, is required, and atropine is to be used. If, however, the wound is peripheral, eserine (one grain to the ounce) may be used to contract the pupil and prevent synechiae. Eserine, however, has a tendency to aggravate any iritis that may occur, so that if signs of iritis supervene its use must be discontinued and atropine substituted.

Rupture of the globe may be produced by a sharp instrument, but more commonly it results from a blow with the fist or some blunt object. In these

latter, so-called indirect ruptures, which are generally situated above and follow the curve of the cornea a few millimetres from the sclero-corneal margin, there is not the same danger of infection at the time of injury, though wounds in the ciliary region are more liable to give rise to sympathetic ophthalmia than those elsewhere.

Treatment. Every case must be weighed on its own merits, and the previous visual acuity of the two eyes must be taken into account in deciding upon the line of treatment to be adopted. There are but few cases where the immediate removal of the eye can be reckoned as a matter of pressing urgency. In all cases the eye must be very gently handled, and a general anaesthetic is often necessary in examining it, before a definite opinion can be expressed as to the chance of saving the eye.

(i) An attempt may be made to save the eye.

(ii) Excision may be performed.

(i) In the first class of cases the eye is first irrigated, a speculum is introduced, and then any prolapsed iris is cut off and freed from the edge of the wound. Fine silk stitches may be inserted in

the sclera, but they must not penetrate the whole thickness of this coat. Silk sutures are used for the conjunctiva. After a final irrigation a pad and bandage is applied. Atropine is instilled before tying the eye up, if the anterior chamber is formed.

(ii) Excision is called for in extensive ruptures, particularly if a large quantity of vitreous has been lost, with, perhaps, extrusion of the iris and lens.

Operation. A general anaesthetic is given, the eye is irrigated, and a speculum introduced.

The conjunctiva is grasped with fixation forceps close to the cornea, and it is then divided all round the cornea with a pair of blunt-pointed scissors curved on the flat. The subconjunctival space is then opened up with scissors as far back as the insertion of the recti muscles. The tendons of these muscles are caught up in turn on a strabismus hook and divided as near the globe as possible. The speculum is then unscrewed and pressed back into the orbit, when the eye will start forward, and is lightly held by the fingers of the left hand.

A strong pair of blunt-pointed, curved scissors

are then passed, closed, far back into the orbital cavity; the optic nerve felt for, and divided with one cut. The scissors which were used for circumcising the cornea must not be used for this purpose, as the conjunctival sac cannot be rendered perfectly sterile. To remove the eyeball the tendons of the two oblique muscles only require division. The cavity is irrigated, and the divided edges of the conjunctiva brought together with a purse-string horschair suture. The application of a firm pad and bandage is generally sufficient to control the hæmorrhage.

There is a large group of doubtful cases which may be treated with cold compresses, atropine, and rest, and after a few days a more definite opinion may be formed as to whether or not the eye can be saved.

The above conditions are always serious, and cases with prolapse of iris call for early operative interference, and should not be the subject of expectant treatment.

V. INJURY TO THE EYE BY BURNS, CORROSIVES, ETC.

Should a patient be seen a few minutes after an injury by an acid or an alkali, an attempt may be made to neutralise it.

In the case of an *acid*, a solution of sodium bicarbonate, ten grains to the ounce, is used.

For injury by an *alkali*, vinegar may be used. Otherwise it is best to flush out the conjunctival sac with warm boracic, or water.

Lime is apt to produce a considerable degree of destruction, but fortunately it is usually more or less slaked. A strong solution of cane sugar is used to wash the eye out ; water would help to complete the slaking. All particles must be carefully removed from the globe and the conjunctival sac.

Atropine ointment is used, and the eyes lightly bandaged in the treatment of these conditions, and a cold-water compress will usually be found to give relief. The after-treatment must be directed towards limiting adhesions as much as possible.

Grains of gunpowder in the cornea and con-

junetiva require removal with a needle ; they may often be snipped out of the conjunctiva with a pair of seissors. They should also be removed from the lids and faee, to avoid permanent pigmentation. In bad cases a general anaesthetic is needed, and atropine and eold applications are to be applied afterwards. If any grains of gunpowder have been removed from the cornea, the eye must be bandaged.

VI. SOME DISEASES OF THE EYE THAT REQUIRE URGENT SURGICAL TREATMENT

(*a*) In *ophthalmia neonatorum* the lids should be everted daily and painted with a solution of silver nitrate, ten grains to the ounce, especial attention being paid to the retrotarsal fold. The eyes should not be tied up, and every attempt should be made to prevent secretions being retained in the conjunetival sae ; and above all, to avoid injuring the cornea in any way, as the prognosis depends upon its integrity. A perehloride of mereury lotion, 1 in 5,000, and warm water, are used alternately every hour through the day, and at longer intervals

during the night. Boracic ointment may be used to smear along the lid margins at night.

Both eyes are usually attacked at the same time, but even if they are not, it is almost impossible to prevent infection of the second eye.

(*b*) *Gonorrhoeal ophthalmia* in the adult is a much more serious disease than in the infant. It begins in the large majority of cases in one eye, and every attempt must be made to save the other.

To this end the lid of the sound eye is everted and painted with silver nitrate solution, ten grains to the ounce, and a Buller's protective shield is then applied to this eye. Special attention must be paid to the strapping adhering firmly in the region of the bridge of the nose ; it will require periodic readjustment. The patient should be directed to sleep with the affected side downwards.

Silver nitrate and the perchloride lotion should be used as in the case of the infant. In washing out the eye a small *rubber* syringe should be used, and the attendant should wear protective glasses.

(*c*) A *corneal ulcer*, especially if it is in an unhealthy condition and attended with hypopyon, will often

need cauterisation, and the most convenient method is to do this with pure liquid carbolic acid.

The eye is anaesthetised with cocaine, the extent of the ulcer having been previously ascertained by using a drop of a two per cent. solution of fluorescin. The eye is steadied, and the region round the ulcer dried with a gauze sponge, or a piece of clean blotting-paper. A small camel's hair brush cut down, or the end of a wooden match is then dipped into the pure carbolic acid and the wound is cauterised, care being taken that the fluid does not run about. Atropine is then instilled and the eye tied up.

(*d*) *Acute glaucoma.* In this important disease, if proper and prompt treatment is employed, a degree of sight may be recovered which is but little below what it was before the attack.

If wrongly treated, or if treatment is delayed for a few days, the sight may be irreparably lost.

Iridectomy is the operation that is called for, and it should be performed in an upward direction, unless the iris is here markedly narrowed, when the broadest part of the iris may be selected. The

shallowness of the anterior chamber, with the forward position of the lens, is one of the chief causes that renders this a difficult operation.

The instruments which are required are: eye speculum, fixation forceps, a narrow-bladed Graefe knife, iris forceps, iris scissors, and a repositor.

Eserine is to be instilled into both eyes before the operation.

Operation. Under general anaesthesia.

The eye is irrigated and the speculum inserted. The conjunctiva is fixed and the eye drawn down and a domed flap from 2 mm. to 3 mm. in height is cut. The puncture and counter-puncture should be from 1 mm. to 2 mm. from the apparent corneal margin, and the incision should maintain this distance from the cornea throughout its entire length; the knife should be kept parallel to the plane of the iris while passing in front of it. The section should be made very slowly and a conjunctival flap cut above. The fixation forceps are then handed to the assistant who draws down the eye. The surgeon introduces the iris forceps, closed, and catches the iris which is drawn well out of the

wound, and while traction is maintained on one end, this end is divided with the iris scissors. Its base is then torn through and the other end drawn out and divided. The repositor is now used to replace the iris and free its pillars from the edges of the wound. The eye is then tied up.

The following points should be borne in mind :—

(i) The wound should be in the sclera.

(ii) The iris should be removed right down to its root.

(iii) A wide iridectomy should be done, and a fifth of the circumference of the iris at the corneal margin removed.

The palliative methods which may be employed for acute glaucoma temporarily in an emergency are :—

(i) Eserine. A strong solution of the sulphate, four grains to the ounce, is used in drop form, and it may often be beneficially combined with cocaine, twenty grains to the ounce. It does no good unless it contracts the pupil. The value of eserine, as compared to iridectomy, has been aptly likened to

the relative value of taxis, as compared with a radical cure, in strangulated hernia.

(ii) The general treatment is of importance. A brisk purge should be given, sleep induced by morphia if necessary, and the patient kept warm in bed and not denied food.

(*e*) *Orbital cellulitis.* From whatsoever cause arising, this condition requires immediate treatment, chiefly on account of the risk of septic meningitis supervening. An incision is made in the lid in the locality where pus is suspected and free drainage provided.

If fluctuation is not obtained, an incision is made over the most tender spot, or an indication can also be obtained of the situation for an incision from the direction of the proptosis ; for instance, if the eye is displaced downwards and inwards, an incision is made into the upper and outer part of the orbit, parallel with the orbital margin.

Foreign bodies within the orbit, and external to the globe, generally require removal, though small bodies, such as shot, are frequently well tolerated. In these cases again, the use of the X-rays has

been of great value in deciding whether the foreign body is in or outside the globe.

(*f*) *In acute inflammation of the lachrymal sac* the abscess which forms is opened by an incision over it, about half an inch in length, and extending downwards and a little outwards. The wound is kept open by a drain.

(*g*) *Sympathetic ophthalmia.* This may attack an uninjured eye, owing to an injury, or to the retention of a foreign body in the other eye. It is extremely rare for it to occur after an injury that causes suppuration in the first eye, unless a foreign body is also retained in it.

Sympathetic irritation is characterised by lachrymation, weakness of accommodation, slight redness, and occasionally pain in the uninjured eye.

Sympathetic inflammation is a very intractable form of plastic irido-cyclitis, which usually has a painless and insidious onset, and follows a similar affection in the injured eye. It is this latter condition which is so much dreaded, and of which sympathetic irritation is often the danger signal.

Sympathetic inflammation may occur, however

without a previous irritation, and irritation is not always followed by inflammation. There is always an interval before the uninjured eye beeomes affeeted. An eye may be retained for three weeks after an injury without much risk, but after that time, if it is not quieting down, it should be exeised exeept under exceptional circumstanees.

Sympathetic irritation arising in the uninjured eye is a strong indieation for the removal of the injured eye; it is always cut short by this procedure.

If sympathetic inflammation has begun in the uninjured eye, the injured eye should not be excised unless it is visually worthless, as it may eventually turn out to be the more useful eye of the two.

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